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AUGUST, 1956

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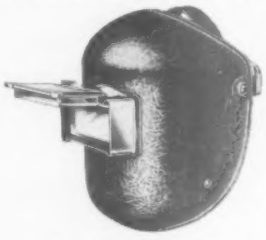

No. 406 Welding Helmet

No. 600 Welding Helmet

Bulletins No. 39 and No. 47 (and Catalog No. 24) describe these and over 20 other styles of Welding Helmets.

Monarch® F-300 Face Shield

Bulletin No. 41 tells about 4 famous Monarch Face Shields and their many accessories.

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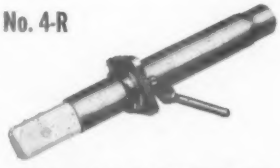

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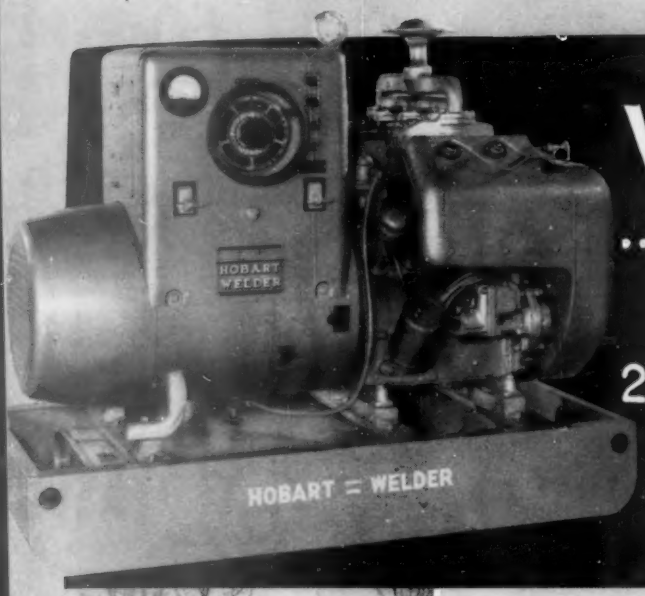

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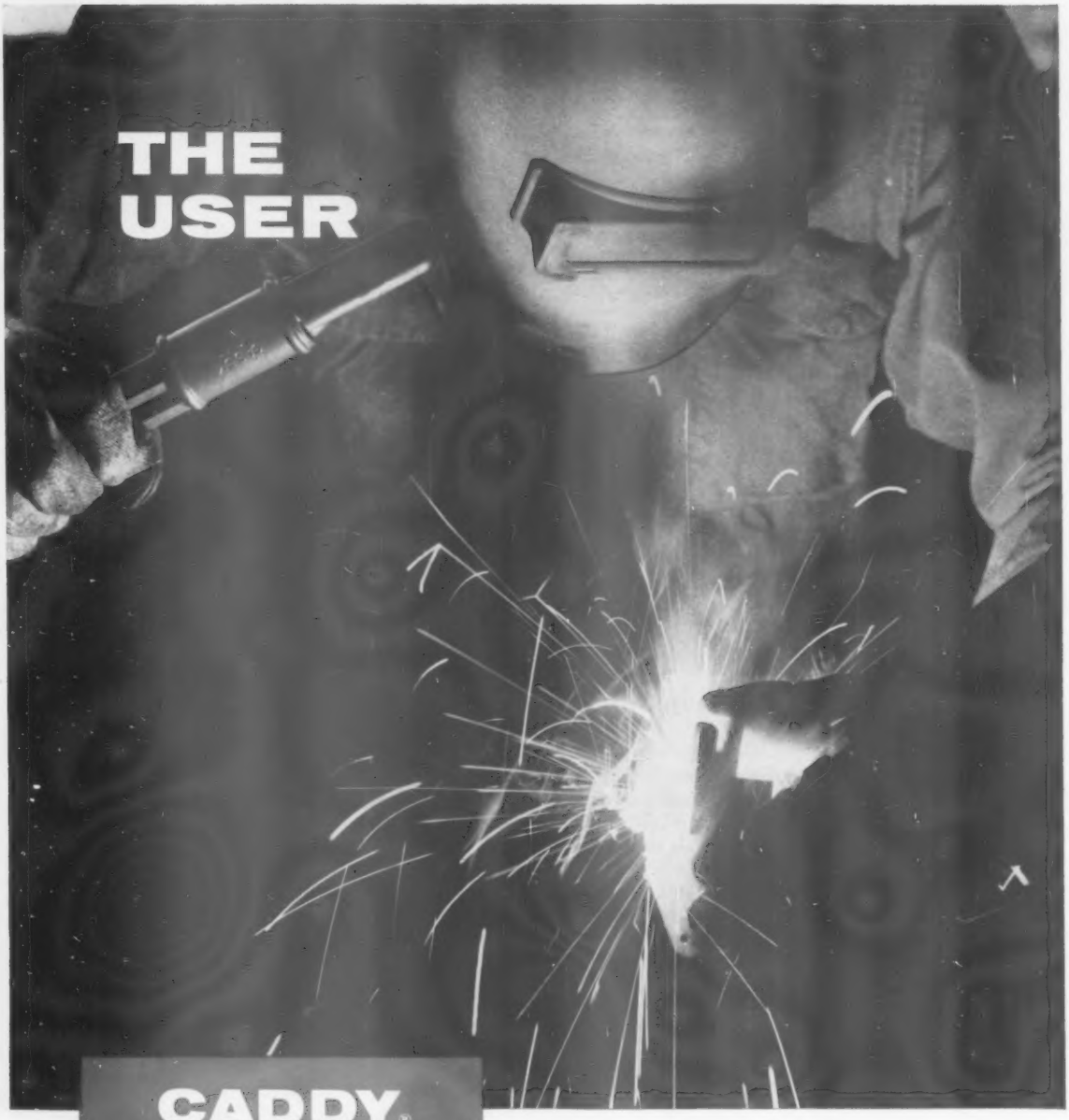

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Welding Engineer

AUGUST, 1956
VOL. 41—No. 8

THE MAGAZINE OF JOINING
AND SEVERING OF MATERIALS

America's pioneer publication which, combined with The Acetylene Journal, has been devoted to the interest of the welding and allied industries since 1898

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Victor automatic hardfacing alloys go on 3 to 4 times faster than manually-applied hardfacing, enable you to make big savings in labor costs. And if you're repairing equipment, cutting down time by ⅔ or ¾ likewise is a terrific saving. You get a more uniform deposit, too, from Victor automatic hardfacing alloys, resulting in longer, more even wear. Check this chart — you'll find there's a Victor type for every hardfacing need.

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33

VICTOR EQUIPMENT COMPANY

ALLOY ROD AND METAL DIVISION

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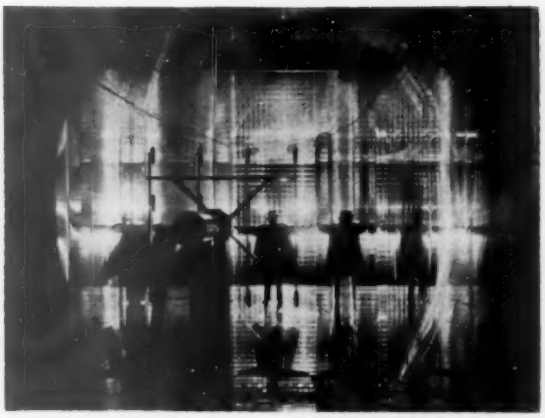
Note even deposit of Victor VA#3 automatic rod on gyratory crusher cones.

TYPE	USES	PROPERTIES AND APPLICATION
VA#1	Crusher Rolls Gyratory Crushers Crusher Mantels Scraper Blades	Rockwell 'C' 54-57 Impact Resistance—good Abrasion Resistance—high AC-DC submerged arc or DC open arc
VA#2	Pinch Rolls Tractor Idlers Tool Joints Coiler Rolls	Rockwell 'C' 50-52 Impact Resistance—good Abrasion Resistance—good Submerged arc only Suitable for multiple passes
VA#3	Roll Crushers Gyratory Crushers Impellors Mill Guides	Rockwell 'C' 54-57 Impact Resistance—good Abrasion Resistance—high For use where abrasion is severe Submerged arc only
VA#4	Tractor Rollers Sheave Wheels Tractor Idlers	Rockwell 'C' 25-28 Impact Resistance—excellent Abrasion Resistance—good Submerged arc only Suitable for multiple passes Machineable
VA#5	Tractor Rollers Sheave Wheels Tractor Idlers Grader Blades	Rockwell 'C' 34-38 Impact Resistance—high Abrasion Resistance—good Suitable for multiple passes Submerged arc only
VA#6	Crane Wheels Roll Necks Pump Sleeves	Rockwell 'C' 38-41 Impact Resistance—high Abrasion Resistance—fair Suitable for multiple passes Deposit machineable Submerged arc only
VA#7	Excellent base for high alloy application. Mine Car Wheels	Rockwell 'C' 36-42 Impact Resistance—excellent Abrasion Resistance—good Suitable for multiple passes Deposit machineable Submerged arc only
VA#8	Tool Joints Grader Blades Scraper Blades Roll Crushers	Rockwell 'C' 51-54 Impact Resistance—high Abrasion Resistance—high Submerged arc only
VT#60	Tool Joints Grader Blades Scraper Blades	Automatic Tungsten carbide wire Abrasion Resistance—excellent (maximum) Deposits are heterogeneous Open arc—DC reverse only

Rod diameters 1/8", 5/32" and 3/16". Standard coil size, 22-1/2" inside diameter, 4" wide, approximate weight 100 lbs.



GLEAMING stainless steel walls of supersonic wind tunnel throat reflect light to produce multi-imaged effect. The throat is shown open to maximum width of almost 6 ft, allowing rushing air to race through. (See story below.)

TRAVELING welding demonstration attracts many visitors. Typical of the interest shown is this group examining welded joints produced by new process. (See story below.)

News

Testing airplanes for supersonic speeds

Airplanes to fly at Jet Age supersonic speeds will be tested in the wind tunnel, Lewis Flight Propulsion Laboratory, Cleveland, operated by the National Advisory Committee for Aeronautics. The stainless steel tunnel throat, illustrated above, will harness man-made winds up to 2,300 mph.

Confronted with precise tolerances, rigid specifications and special steels, all of the steel fabricator's know-how was called into action in constructing the throat. Welding was ticklish, requirements necessitated constant visual checks. Completed work was subjected to severe tests.

—United States Steel Corp.

Airco to build in Los Angeles

Air Reduction Pacific Co., San Francisco, will build a new air liquefaction plant in the Los Angeles area. Air Reduction Pacific is the West Coast industrial gas and welding products division of Air Reduction Co., Inc., New York City.

The new plant is expected to produce 55 tons daily of high purity liquid oxygen, 15 tons of liquid nitrogen and 3½ tons of liquid argon. The cost of the plant will be in excess of $7,500,000, it is reported.

Scheduled for completion during the second half of next year, the new plant will be the fourth air liquefaction plant for Air Reduction. The company now operates such installations in Butler, Pa., *(see story elsewhere in this issue)* and Riverton, N. J., and is constructing an air liquefaction plant in Chicago.

457,000 scientists needed by 1965

The nation faces a shortage of 457,000 scientists and engineers by 1965, according to a study by the Manufacturing Chemists' Association, Washington, D. C.

The MCA study reports that, at present, there are 884,000 scientists and engineers employed in this country. Of this number, 713,000 are in industry, with 77,000, or 8.7% of the national total, employed in chemical and allied industries.

By 1965 it is anticipated the supply of scientists and engineers will increase to 1,223,000 but that 1,680,000 will be needed.

A. O. Smith puts its show on the road

As a result of the interest shown at Buffalo in its new "C-Omanual" welding process, A. O. Smith Corp., Milwaukee, is demonstrating the semi-automatic equipment in large market areas throughout the nation.

The itinerary: Milwaukee, Chicago, Detroit, St. Louis, Cleveland, Pittsburgh, Philadelphia and New York City. The exhibits began during the last week in May and will continue through September. The hand-gun, carbon-dioxide-shielded, Mig process was first introduced at the Welding Show in early May.

The program usually consists of five week-day sessions, running from 7 to 11 p.m. in each city. The firm is allowing a week's travel time and respite between weekly programs. In cities where Smith has its own facilities or branches the demonstrations are conducted there. But for the most part halls have to be rented.

Attendance (by written invitation) has been in the hundreds in most cities. Visitors are also invited to bring in sample workpieces that might be welded in the "C-Omanual" shop.

Foote Mineral plans production expansion

Foote Mineral Co., Philadelphia, has begun expansion of production facilities of its electromanganese division, Knoxville, Tenn. The new construction, expected to cost $2,000,000, is planned for completion in early 1958. The expansion is expected to double the capacity of the firm's Lorraine St. plant, newest of the division's two operating units.

TOP honor of the year is presented to representatives of welding supplier by C. L. Stocker, left. Accepting the award are Ira Felkins and Doc Raymond. (See story below.)

PRESENT at recent open house were (left to right) Roy Stroessenruether and Ira Yates, Miller Electric Mfg. Co.; Bill Hart, Valley Welding Supply, Inc.; Steve Owings of Miller; Ed Hart of Valley Welding; Herb Saling, Appleton Machine Co. (See story below.)

Lincoln announces dealer of the year

California Welding Supply Co., Stockton, Calif., has been selected dealer of the year by The Lincoln Electric Co., Cleveland.

A plaque naming the California firm 1955 Weldealer of the year was awarded by Al Patnik, dealer sales manager of Lincoln. Doc Raymond, president, and Ira Felkins, vice-president, of California Welding, accepted the award from C. L. Stocker, Lincoln's district engineer in the San Francisco area.

The award is made annually to pay tribute to the dealer who has developed the most effective program for promoting welding during the past year.

California Welding Supply developed a nine point program, which included complete coverage for all types of welding prospects, an active training program for the company's personnel, welding demonstrations and open houses, welding contests, school contests, active promotion and follow-through.

Dedicate new M & T general offices

The new general office building of Metal & Thermit Corp. was officially dedicated at an open house recently at the Metal & Thermit center in Rahway, N. J. More than 700 persons attended the open house, including Robert B. Meyner, governor of New Jersey.

The dedicatory ceremony was held in a large tent erected on the grounds adjacent to the new office building. Speakers featured were H. E. Martin, M & T president; William H. McLean, president, chemical division, Merck & Co., Inc., and Governor Meyner. Following the speakers, a box luncheon was served. Guests were then conducted on guided tours through the new offices.

The office building, a two-story, 80 by 180 ft structure, houses 250 general office employes. Of yellow-brick construction, it is air-conditioned and equipped with its own cafeteria.

The M & T center, of which the new office is a part, combines office, research and distribution activities, representing a total value of over $2,500,000. The research laboratory, erected in 1942, is currently being expanded to provide additional facilities, including pilot plants and semi-works for organic and inorganic chemicals.

AWS sets dates for 1957 convention

The American Welding Society, Philadelphia, will hold its 5th Spring and 38th Annual Meeting, April 8-12, at the Hotel Sheraton, Philadelphia. Also scheduled for April will be the Fifth Annual Welding Show to be held April 9-11 at Convention Hall, also in Philadelphia.

It should be noted that this scheduling presents a conflict with the 57th Annual Convention of the International Acetylene Association to be held April 8-10 at the Hotel Nicollet, Minneapolis. As this issue went to press the conflict had not been resolved.

The AWS has also announced that its 1958 welding show, originally scheduled for Milwaukee, will be held in Kiel Auditorium, St. Louis, Mo., during the third week of April.

Valley Welding Supply has open housewarming

To introduce its new modern home, Valley Welding Supply, Inc., Appleton, Wis., held an open house. A total of 375 persons registered at the housewarming, interested to inspect the new modern building at 1828 W. Wisconsin Ave., Appleton.

Suppliers of Valley Welding cooperated in exhibiting and demonstrating equipment to the guests. Among them were Alloy Rods Co., National Cylinder Gas Co., Miller Electric Mfg. Co., A. O. Smith Corp., American Manganese Steel Division, Bay State Abrasive Products Co., Heath Engineering Co. and Aronson Machine Co.

The new location provides increased floor space, modern dock facilities and an attractive display room. William T. Hart is president of Valley Welding Supply, Inc.

Union Carbide plans new facilities

Union Carbide & Carbon Corp., New York City, has completed construction plans for its 280-acre site near Tarrytown, N. Y. The Westchester property, in the towns of Greenburgh and Mount Pleasant, was purchased in 1952.

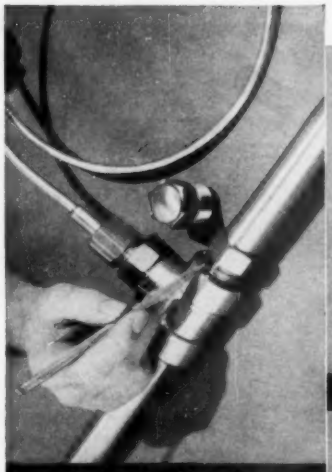
Structures planned are: an office building for sales departments of several divisions; basic research laboratory to conduct general research; service laboratory for research in customers' problems.

Construction of the new buildings will begin early next year, with completion expected early in 1959. The

(Continued on page 88)

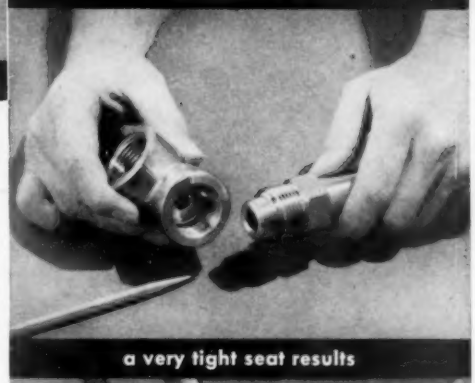
compound Pressure®

the new and better cylinder manifold...



only the bushing turns

threads do it



a very tight seat results

a simple wrench does the job

The new compound pressure* cylinder manifold is made of the sturdiest die forgings and extruded rods; all are drilled for uniform inner dimension. The leak proof joint which results from the compound pressure design is tighter and more leakproof even than the well understood and long used connection between regulator and cylinder valve. The big improvement of this new invention lies in these facts: you can have any competent mechanic assemble a cylinder manifold to your own or our specifications with the assurance of absolute alignment and permanent leak proofness. Yet, the resulting cylinder manifold may be disassembled at any time, stored or moved and reassembled when required. It may be extended when needed, redesigned when desired, stored in bins as individual fittings. Only the bushings move in assembly, thus absolute alignment is certain.

*patents applied for

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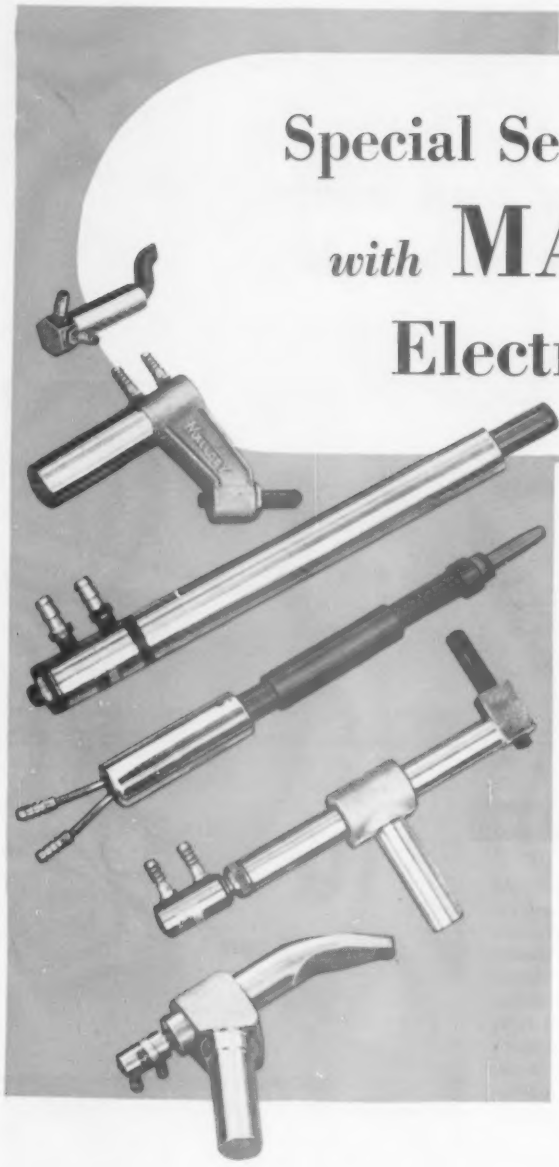

BEFORE you go to the time and expense of getting a custom-made holder for a welding job, take a look at the variety of standard Mallory Electrode Holders. You can probably pick out the design your application requires . . . at substantial savings in cost and delivery.

The most complete line in the industry, Mallory Electrode Holders offer many varied designs . . . straight, offset, paddle type, swivel head, low inertia, universal and close-coupled. Light, standard and heavy-duty models are available for pressure ranges from under 100 lbs. to more than 6000 lbs.

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Look through the Mallory Resistance Welding Catalog and pick out a series of holders that will equip your shop for the range of work you are doing. Your nearby Mallory distributor will be glad to give you a copy of this useful catalog and to help in your selection . . . or you can get one by writing direct to Mallory.

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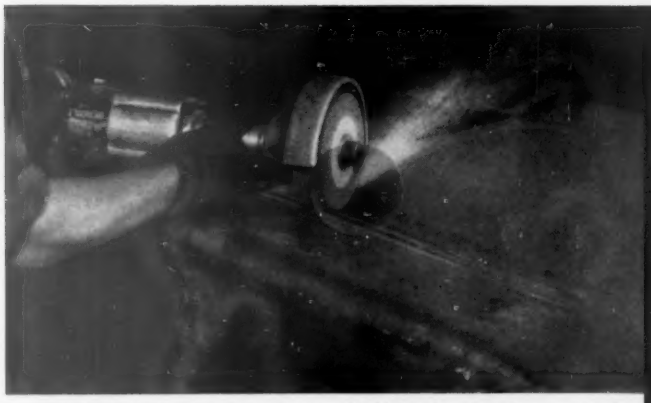
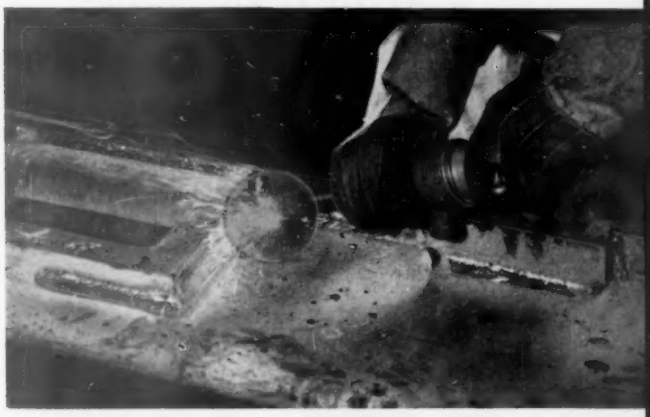


STRAIGHT WHEEL in Norton B11 resinoid bond makes short work of smoothing a heavy weld. Abrasive is ALUNDUM* aluminum oxide — tough and strong.

FLARING CUP WHEEL in Norton B11 resinoid bond employs a rotating guard. This, together with the B11's better balance, means easier, safer grinding.



CONE WHEEL in Norton B11 resinoid bond is easier to use in a hard-to-reach spot such as this fabricated machine base. Result is faster, more profitable grinding.

DOUBLE PROTECTION. The improved pronged-anchor threaded steel bushing which is molded into the back of Norton cup wheels, shown with the revolving cup guard. Both serve to hold pieces together in case of accidental wheel breaking.

One sure way to faster, better weld grinding

Norton B-11 resinoid bonded wheels are perfectly balanced to bring important **"TOUCH of GOLD"** *advantages . . .*

Perfect balance is one good reason why Norton B11 resinoid bonded wheels are best for your heavier weld grinding jobs. They "hug that work" closer, with least possible vibration and bounce.

B11 wheels have been thoroughly job-tested. They speed the work because they cut cool, cut fast and reduce operator fatigue. And improved processing methods assure uniformity from one wheel to another.

The result is much better weld grinding at much less cost.

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for details on the new B11 resinoid bonded wheels. Or write to us direct. And remember, only Norton offers you such long experience in both grinding machines and wheels to help you produce more at lower cost. NORTON COMPANY, Worcester 6, Mass. Distributors in all industrial areas, listed under "Grinding Wheels" in your phone book, yellow pages. Behr-Manning, Troy, N. Y., division of Norton Company.

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Address .....

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AUGUST
1956

Your *WeldWorld* at press time

Last minute news of interest to those engaged in joining and severing materials.

. . $2,000,000 is a staggering sum to be losing every day. But that is what the steel strike is costing the welding industry, and it can never be regained.

. . Some "experts" look upon the strike as a blessing in disguise. Although the usual summer lull will be prolonged, these "experts" feel that shortened supplies of steel now will mean a larger, longer boom to fill supply lines later . . . after peace returns to the scene. All is contingent, naturally, upon an early settlement.

. . Domestic copper price line has finally been broken. Phelps Dodge Corp. cut price per pound to 40 cents— a 6-cent slash. The 46-cent copper has been around since mid-February. Inco of Canada made a similar cut for Canadian customers . . . but the Phelps Dodge reduction was first in the United States for some time, despite much lower world market price. Kennecott Copper Corp. cut its price 6 cents the following day.

. . Nickel shortage is so acute that even lapse in steel production caused by strike will not allow for sufficient stockpiling.

. . Looks like September will be lowest automobile production month of the year. Predictions are that fewer than 200,000 cars will be turned out. Chief reason: model changeovers for 1957.

. . Census Bureau reports that oil-field machinery and tools industry (which includes plenty of welded and hardfaced products) last year was a $513,000,000 business.

. . Apparently the federal government will not finance a proposed Texas-to-California welded pipeline for crude oil, though it has approved a rapid tax write-off for a portion of the project.

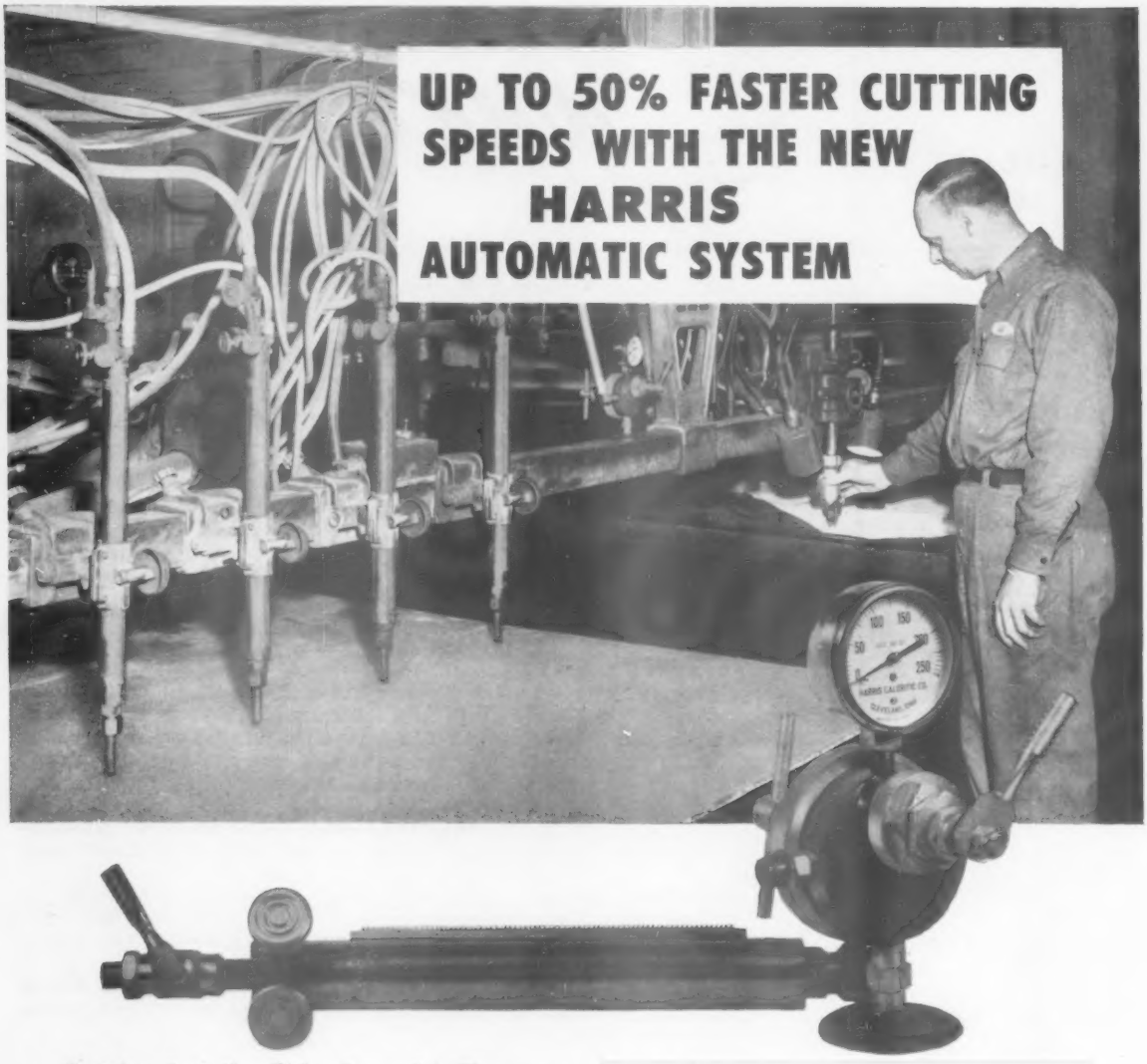
. . Office of Defense Mobilization will again stockpile copper now that the shortage is ended.

. . Joint report out of Labor and Commerce Depts. shows construction activity rose to record high in first half of 1956. Six-month total value of all new construction, one of the barometers of national economy, was $20 billion.

. . Net working capital of United States' corporations was $2 billion higher in first three months of this year than at end of 1955. Securities and Exchange Commission reports total $105.6 billion on April 1.

. . Aluminum production is keeping pace with last year's output, but some predictions are for an over-all 10% increase over 1955 by end of current year.

. . Shipbuilding—an industry where welding abounds—in 1956 is expected to double its output of last year.



It takes just the flick of a wrist. You can now control pre-heat oxygen pressures to as many as eight machine cutting torches simultaneously! Working from your regular operating position, and using the new Harris system, you get unbelievably smooth, fast cutting results!

You get faster starting, piercing and cutting than ever before with the Harris unit. Independent control of the starting flame enables you to vary one without affecting the other.

Write us for further details on this remarkable Harris unit, or call your nearest distributor.

- ✓ Up to 50% faster cutting speeds over older methods.
- ✓ 80% reduction in consumption of pre-heat oxygen. Overall oxygen consumed lowered. 20%.
- ✓ Slag removal reduced to a minimum.

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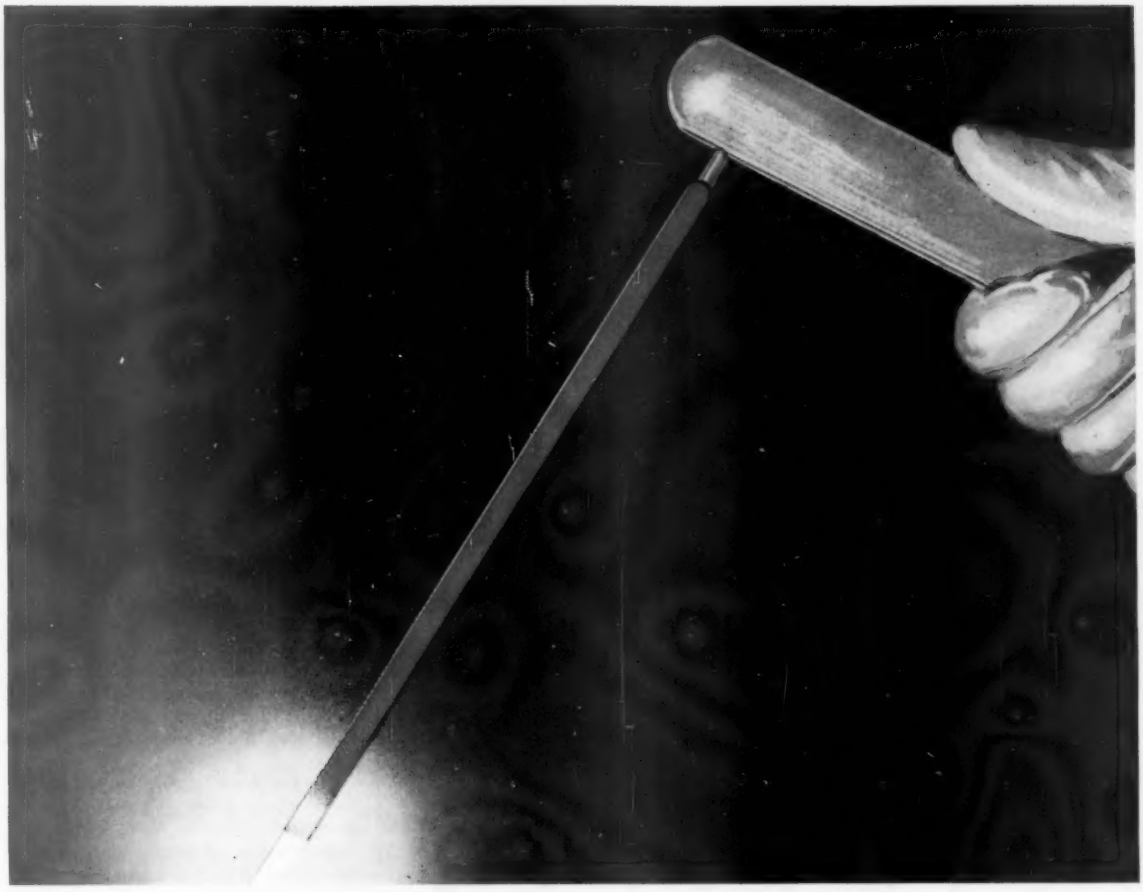

Fabricator welds 5 dissimilar alloy combinations with Inco-Rod "A"

Proves electrode's versatility

Time after time, Inco-Rod "A"* proves successful in welding dissimilar alloy combinations.

Think of the *variety* it welds for just one fabricator.

In producing evaporators, this company joins 2¼% Chromium—1% Molybdenum Steel to 347 Stainless. Inco's Technical Service representative reports: 'good fusion and sound welds are obtained. Operator likes the way Inco-Rod "A" handles.'

In distilling equipment, they weld 1020 Carbon Steel to 70/30 and 90/10 Copper-Nickel Alloy. The report: 'Inco-Rod "A" gives excellent results . . . good bead appearance and fusion . . . no porosity or cracking.'

Results are similar in welding SA-266 carbon steel to 70/30 Copper-Nickel and Monel* nickel-copper alloy for a heat exchanger. 'Better arc control than with previous electrode . . . pin holes are reduced about 80%.'

But successful welds are not surprising with Inco-Rod "A" . . . the new electrode with the distinctive *green* flux coating. It welds *most* dissimilar alloy combinations . . . both between and among ferritic and austenitic stainless steels, low alloy steels, mild steels, high nickel alloys, and other alloys.

Welds are strong and ductile . . . of X-ray quality. Corrosion resistance usually equals or exceeds that of the base metal. And operability is excellent in any position . . . spray type arc . . . easy slag removal.

Are *you* having trouble welding dissimilar alloys? Chances are good that Inco's Technical Service can help you. Write us giving details.

*Registered Trademark

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO-ROD "A" electrode is supplied in 14-inch lengths in four diameters, 3/32-, 1/8-, 5/32- and 3/16-inch (the 3/32-inch is center grip) packed in 5-lb. containers (NEMA color coded).

INCO **Welding Products** • electrodes, wires, fluxes

Best quality chisel steel
Unbreakable steel shaft
Head silver brazed to shaft
Metal or wood grips
Model H Cone and Chisel one of 27 models

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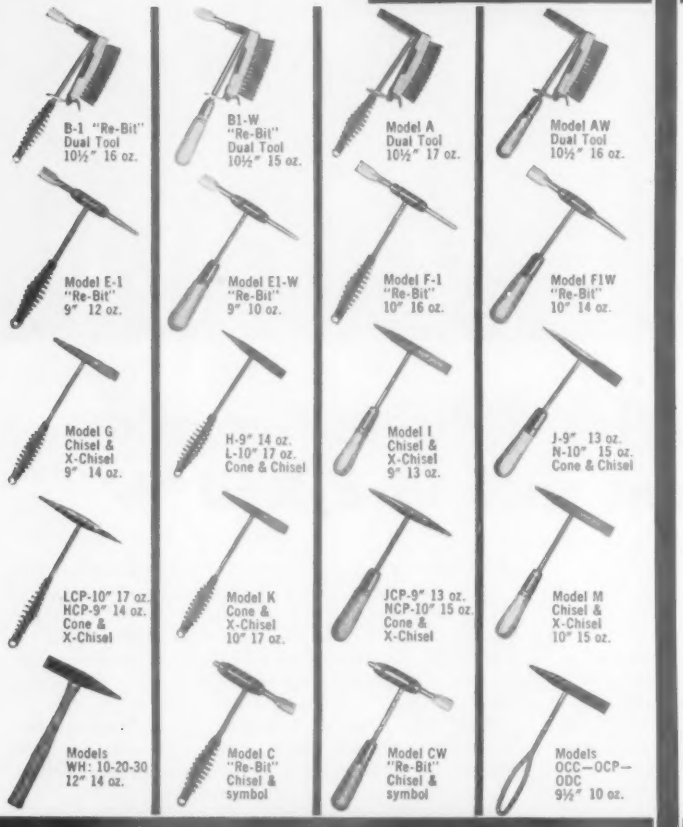
B-1 "Re-Bit" Dual Tool 10½" 16 oz.
B1-W "Re-Bit" Dual Tool 10½" 15 oz.
Model A Dual Tool 10½" 17 oz.
Model AW Dual Tool 10½" 16 oz.
Model E-1 "Re-Bit" 9" 12 oz.
Model E1-W "Re-Bit" 9" 10 oz.
Model F-1 "Re-Bit" 10" 16 oz.
Model F1W "Re-Bit" 10" 14 oz.
Model G Chisel & X-Chisel 9" 14 oz.
H-9" 14 oz. L-10" 17 oz. Cone & Chisel
Model I Chisel & X-Chisel 9" 13 oz.
J-9" 13 oz. N-10" 15 oz. Cone & Chisel
LCP-10" 17 oz. HCP-9" 14 oz. Cone & X-Chisel
Model K Cone & X-Chisel 10" 17 oz.
JCP-9" 13 oz. NCP-10" 15 oz. Cone & X-Chisel
Model M Chisel & X-Chisel 10" 15 oz.
Models WH: 10-20-30 12" 14 oz.
Model C "Re-Bit" Chisel & symbol
Model CW "Re-Bit" Chisel & symbol
Models OCC—OCP—ODC 9½" 10 oz.

You Can't Beat ATLAS Quality

The modern Atlas plant is devoted exclusively to building the finest weld cleaning tools in America. There are models to suit the man and every type work. If you haven't tried Atlas you don't know what a difference "balance and feel" can make in production and quality of work. They can take it.

ATLAS WELDING ACCESSORIES INC.

707 E. LEWISTON AVENUE, FERNDALE 20 (DETROIT) MICH.

Letters should be addressed to: The Editor, WELDING ENGINEER, 12 E. Grand Ave., Chicago 11, Ill. No letter will be published unless signed, but your name will be withheld if requested.

Welding school

Dear Sir:

The June issue of WELDING ENGINEER, page 19, had several letters stating there should be more schools set up for teaching welding. We have a good school for that as well as several other needed divisions of industrial engineering.

We are in our eleventh year of operation. Many of our graduates have their own shops. Those that choose to roam, I am sure, are able to secure a good living.

Every student, during the course of his academic training, is given the opportunity to work in the R. G. LeTourneau plant in all phases of equipment fabrication as well as procedure control and methods practices.

One of my fall graduates has already been accepted by a prominent welding equipment manufacturer. One other is going on foreign assignment upon completion of his work this autumn.

Don R. Taylor
LeTourneau Technical Institute of Texas

Extruded electrode

Dear Sir:

For many years we have been subscribers to WELDING ENGINEER and are pleased to say that the contents are of utmost interest to us and always topical.

When reading the May issue we were amazed, however, to see the advertisement, pages 26 and 27, of Eutectic Welding Alloys Corp., Flushing, N. Y., bearing the title: "First Aluminum Electrode with extruded coating."

This statement may mislead readers since WELDING ENGINEER is international in scope. It may be quite right that Eutectic is first in manufacturing an extruded aluminum electrode in the United States. On the other hand, it must be pointed out that our electrode

(Continued on page 79)

NEW "Unionmelt" Welding Assemblies

for greater job versatility- performance dependability

Versatility and dependability are yours at an all time high in an improved new line of UNIONMELT welding assemblies . . . These units embody the greatest variety of machine combinations, job applications, and design features ever offered for submerged arc welding.

Wire feed units are simply constructed and are highly efficient . . . Identical mounting dimensions for heads, brackets, and slides allow for any number of desired assembly combinations.

Welding heads have exceptional flexibility because of sturdy new mounting fixtures which provide for vertical, horizontal, and rotary adjustment. Stationary and self-propelled combinations are also available.

The wide variety of standard and custom UNIONMELT welding assemblies can easily be made to fit your particular applications—at costs lower than many current standard models.

See your local LINDE *representative today for information on the many other new features—or write for free illustrated literature.*

Linde Air Products Company
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.

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The terms "Linde" and "Unionmelt" are registered trade-marks of Union Carbide and Carbon Corporation.

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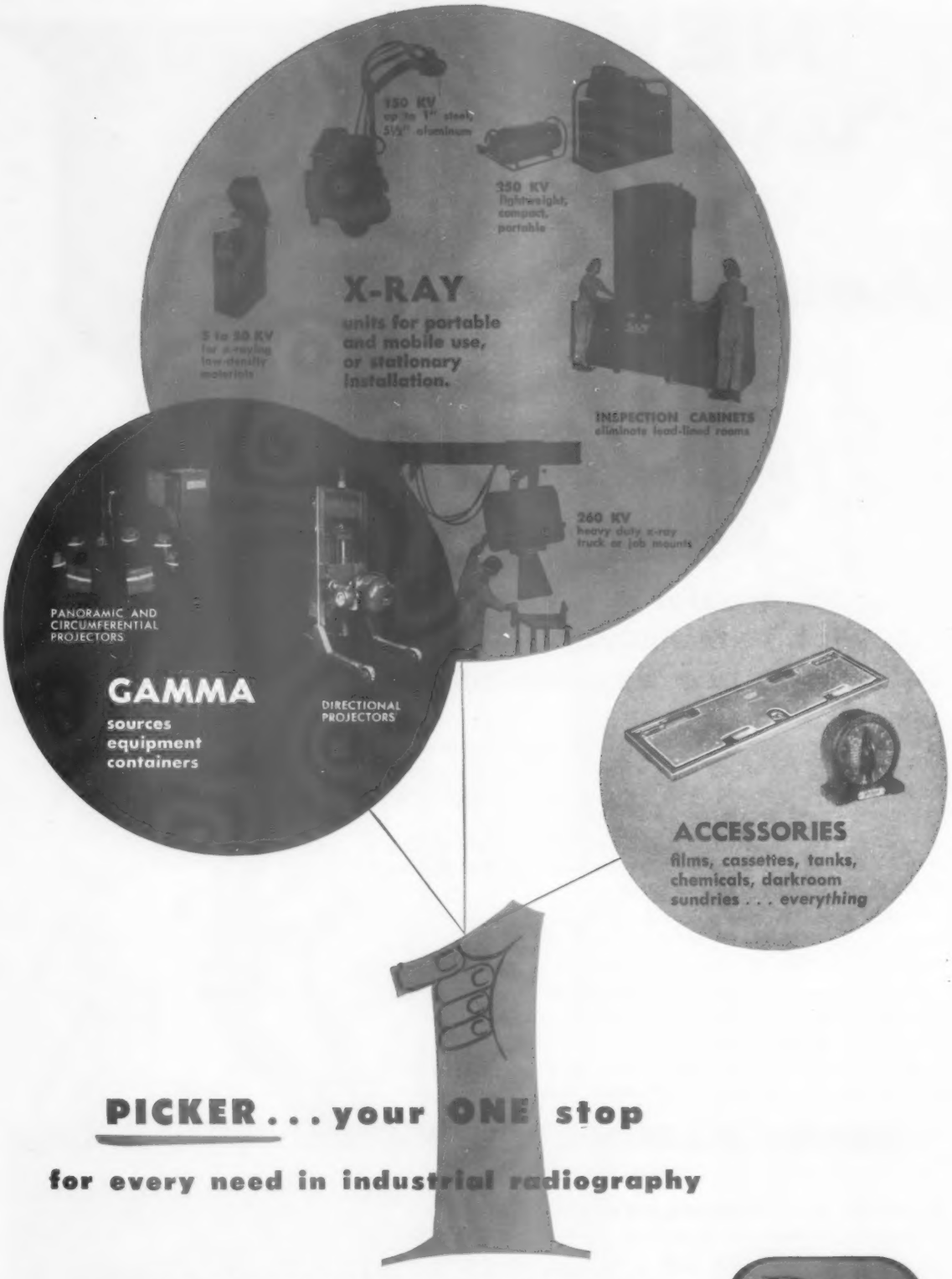

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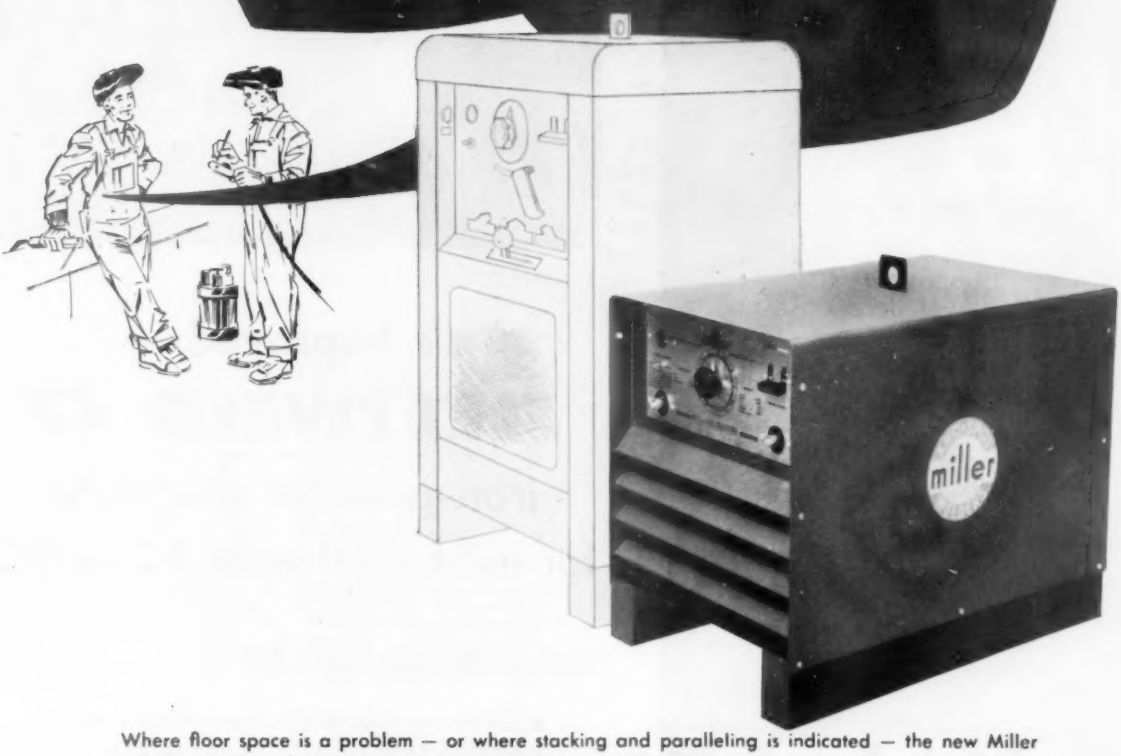
for every need in industrial radiography

PICKER X-RAY CORPORATION, 25 SO. B'WAY, WHITE PLAINS, N. Y.

BRANCHES IN PRINCIPAL CITIES IN U.S.A. and CANADA

Picker x-ray

say, see the new **miller** *SRH low-boy?*



Where floor space is a problem — or where stacking and paralleling is indicated — the new Miller SRH LOWBOY is the engineered-to-your-needs answer! This dc rectifier type welder is available in three models with 60% duty ratings of 200, 300 and 400 amperes. Combining compactness with quiet operation, minimum arc blow, top electrical efficiency and waterproof construction, the LOWBOY is *another* Miller first that "figures."

Upright SR models to 600 amperes at 40 volts with 750 amperes maximum output; Duplex units up to 1200 amperes, 40 volts, 1500 amperes maximum.

". . . if it's MILLER you know it's the finest . . ."

New

MILLER ARCWELD welding electrodes are worthy of the MILLER name and reputation. Ask your distributor for some . . . you'll like the job they do.

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ELECTRIC MANUFACTURING CO., INC.

APPLETON, WISCONSIN

Distributed in Canada by
Canadian Liquid Air Co., Ltd.,
Montreal, P.Q.

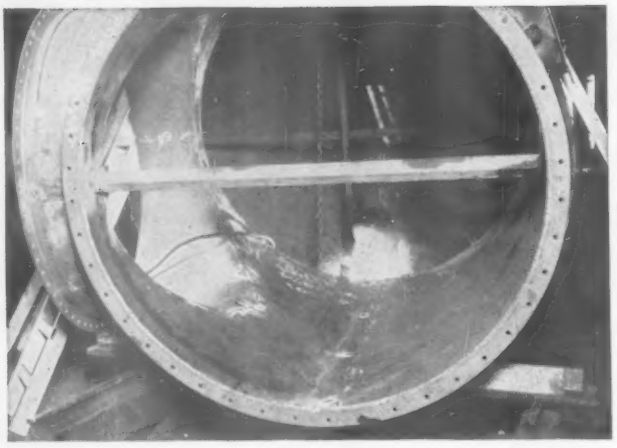
When an electrode with the speed of Jetweld

Has easy operation in all positions

Yet costs less than other iron powder electrodes

WHY

use anything but Improved FLEETWELD 47 on hard-to-position jobs



Improved
FLEETWELD 47
iron-powder electrode for mild steel with AC or DC

cuts welding costs by:

- having one electrode for downhand and out-of-position work
- easier welding with no tendency to sticking
- higher deposition rate . . . 10% to 30% faster arc speed
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than conventional E-6013 electrodes.

Send for Specifications and Procedures in Weldirectory SB-1351.

THE LINCOLN ELECTRIC COMPANY

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LINCOLN . . . *one dependable source for all your welding needs*

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AUGUST, 1956

Welding Engineer

ESTABLISHED 1916

Wanted: more know-how

For the second time in 16 years, WELDING ENGINEER *has a guest editorial writer. Paul G. Hausman, professor and chairman, mechanical engineering department, University of Kansas, sends a letter commenting on our editorials in two recent issues. His June 21 letter dealt with the creation of better teaching facilities in schools and colleges. We appreciate his comments and would like to share them:*

I WISH to congratulate you on the editorials appearing in the April and May issues of WELDING ENGINEER on the need for better-trained engineers and technicians.

Naturally, I agree whole-heartedly with your idea for creating better teaching facilities, especially in engineering schools.

But I am vitally concerned with the lack of interest in the promotion of welding processes and their engineering applications in the various engineering curricula. I am also concerned with the industry's lack of interest in helping promote better teaching programs that include processing courses.

In your articles you have expressed very well the thinking of most educators as to the reasons why shop or manufacturing processes courses—including welding processes—are not allowed to remain a part of their engineering curricula.

HOWEVER, I think another good reason could be added—industry is not demanding or recommending this type of education for engineers.

Will we have enough future engineers and technicians with the know-how to stay ahead of the rest of the world in production? How can the engineer properly specify and design for welding without technical knowledge and laboratory experience in various metal-joining processes?

If the engineer is not given at least a small amount of this technical know-how, welding progress will be very slow.

If industry says that technical training in the welding area is not important for engineers, then educators will yield to pressures of introducing more humanities and other technical courses in the curriculum.

I also believe that existing welding courses in some engineering schools are of such a caliber that skill is about the only thing stressed.

Welding processes cover an area of work including all the basic sciences. There is no better place in which more science can be included in course content than in welding courses.

IN OUR school of engineering and architecture here at Kansas University, manufacturing processes courses have been almost eliminated in certain curricula. However, all freshman engineers are acquainted with welding processes in a course called "Introduction to Manufacturing Processes."

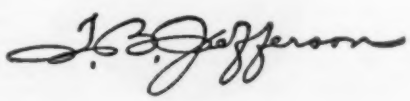
Most mechanical, chemical and electrical engineers are still taking a second course in "Welding Processes"—1-hour lecture, 2-hour laboratory.

Two years ago I introduced another course open to juniors and seniors entitled "Advanced Welding Problems." This course is designed to allow students to pursue one or several phases of welding applications.

Our welding laboratory is quite complete for all phases of welding including resistance, gas shielded and submerged-arc, etc. But we need pieces of equipment which we are not able to purchase—an almost universal situation.

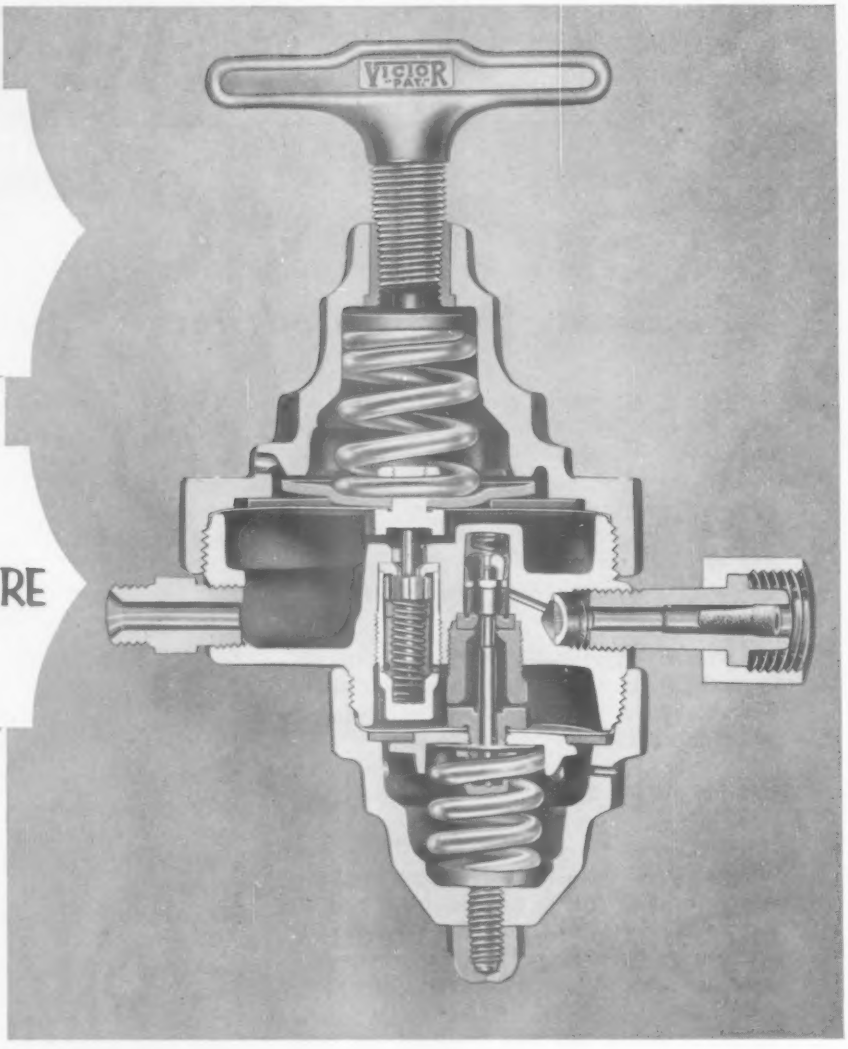
I hope your editorials have created a great interest on the part of industry as well as educators in the creation of *The Foundation for Education in Welding.*

We hope they have, too. This critical problem facing us now won't solve itself. Any solution will be achieved only through unified—and greatly magnified—efforts!



The man on the job prefers **VICTOR** Safety Regulators

THIS INSIDE PICTURE TELLS WHY



Cut-away of Model VTS400 series 2-stage Safety Regulator. Victor makes regulators for almost every gas and use, for pressures to 10,000 p.s.i., and volumes to 28,000 c.f.h.

You Get Greater Safety. All Victor regulators have the "stem type" seat mechanism that closes with the impact of inlet pressure, and is protected from seat ignition because the incoming gas loses its heat of compression by expanding into the inlet pressure chamber before passing over the seat and through the nozzle. Dense die forged bodies and spring housing caps provide maximum strength and durability. High inlet pressure type regulators have a reliable, self-reseating relief valve that insures complete protection. Diaphragms are protected from excessive and damaging movements by "stops" and rubber cushions. A porous sintered bronze inlet filter keeps out injurious dirt and foreign material.

Single and Two-stage Types. Victor offers single-stage regulators to meet most capacity or delivery pressure requirements; and two-stage regulators for operations which require a constant delivery pressure over a range of varying inlet pressures.

Many nationally known companies, small and large, and in all types of industry have standardized on Victor Safety Regulators because of their trouble-free operational characteristics and reliable service.

Call your Victor dealer NOW.

VICTOR for welding

VICTOR EQUIPMENT COMPANY

Mfrs. of welding & cutting equipment; hardfacing rods, blasting nozzles; cobalt & tungsten castings; straightline and shape cutting machines. 32

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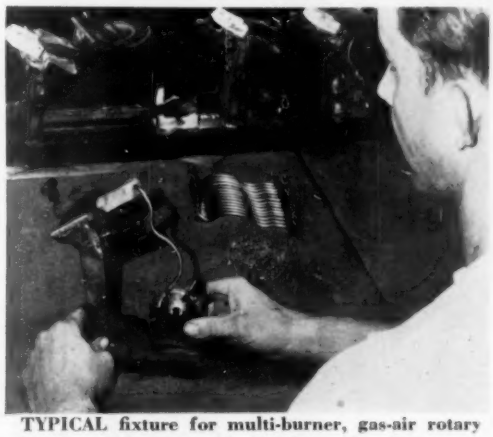
Fixtures for brazing-I

By A. M. Setapen
Manager of Engineering
Handy & Harman
New York City



TYPICAL fixture for multi-burner, gas-air rotary blazing table. Assembly is clamped only at one point to allow thermal expansion. Fixture is cold-rolled steel, has service life of 40,000 cycles. Fabricated by user in quantity at a cost of $20-$25 per unit.

The second and concluding portion of this article will appear in the September issue of WELDING ENGINEER.

DESIGNING work-holding fixtures for brazing with silver filler metals is somewhat like raising children. No single set of rules can cover every problem.

Design of any fixture must take into account the heating method, service temperature, length of cycle, required precision of alignment, convenience, service life and cost. Nevertheless, observance of certain general principles can help avoid fixturing and heating problems.

The following collection of *do's* and *don'ts* is based partially on recommendations of several firms with considerable experience in designing both fixtures and brazing set-ups. Among these are:

Gas Appliance Service, Inc., Chicago (furnace and semiautomatic gas-air brazing); Induction Heating Corp., Brooklyn, N. Y. (induction brazing); Joyal Products Inc., Newark, N. J. (resistance brazing); Technion Design & Mfg. Co., Brooklyn, N. Y. (brazing fixture manufacture).

Before discussing specific design requirements for various heating methods, here are a few basic considerations applying to virtually all brazing fixtures.

Design Requirements

1. Keep the mass of the fixture as low as possible, consistent with strength requirements for service conditions encountered. This reduces heat absorption, increases ease of handling and decreases material costs.

(Low heat absorption by fixtures is particularly important in furnace brazing since it permits closer spacing of work pieces or higher conveyor speed for a given furnace temperature. The amount of heat absorption by a material is a function of its heat capacity and density.)

2. Support the assembly at as few points as possible to minimize heat transfer from the work. In many cases, weight and fit of parts will give the assembly stability along a certain axis. Designing the fixture to support the assembly along this axis can reduce the number of supporting points.

3. Fixture parts must not interfere with either heating of the joint or application of silver filler metal—particularly when handfed.

4. Assembly and fixture almost never expand equally when heated. Fixtures must be designed to maintain proper alignment and clearance of parts and to avoid binding or jamming when assembly is at brazing temperature. In general, if an assembly is clamped or positioned rigidly in one direction it must be free to expand in the opposite direction. Otherwise distortion is likely to occur.

5. For high production it should be possible to unload and reload the fixture while it is hot. Also, fixture design must permit the flux to run off to prevent clogging of surfaces which will be mated later, such as threaded studs.

Fixture Materials

Selection of fixture materials is an important part of fixture design. In many cases it is dictated by the type of heating method used. Two classes of fixture materials are commonly employed—metals and refractory ceramics. Each has its particular advantages and limitations.

Many types of metals are used. As a class they have the following advantages; machinability; fixtures for complex shapes can be assembled by welding or other joining methods; good impact and wear resistance; fixture parts can be replaced if necessary; moderate material costs.

In general, the limitations are: a tendency to oxidation, corrosion, chemical attack and change of hard-

Metal designation	Major alloying elements (%)	Avg. coeff. of expansion microin./in./F	Max. temp. without excessive scaling (F) continuous	Max. temp. without excessive scaling (F) intermittent	Remarks
					MILD
1020	0.15-0.25 C 0.30-1.0 Mn	9.8 (0-1000 F)	800	1000	Scales rapidly. Generally used for simple supporting fixtures or as back-up material not in direct contact with flame. Primarily for torch or multi-flame heating.
					STAINLESS
309	24 Cr 12 Ni	10.8 (0-1500 F)	2000	1800	Moderate thermal shock resistance. Poor resistance to carbon and nitrogen absorption. Oxidation resistance excellent up to 2000 F.
310	25 Cr 20 Ni	10.0 (0-1500 F)	2000	1900	Excellent scaling resistance to 2000 F. Moderate thermal shock resistance. Fair to good corrosion resistance in neutral or mild carburizing atmospheres. Better sulphur resistance than higher nickel alloys.
430	17 Cr	6.3 (0-1500 F)	1450	1550	Scales rapidly above range, but develops tightly adhering scale within range. Lower coefficient of expansion than nickel steels.
446	27 Cr	6.2 (0-1500 F)	1900	2000	Superior oxidation resistance. Good thermal shock properties. Has reduced formability and ductility.
					HI-TEMP. ALLOYS
Nichrome	60 Ni 16 Cr	9.0 (80-1800 F)	1800	1800	Excellent oxidation resistance to 1800 F.
Inconel	72 Ni 14-17 Cr 6-10 Fe	9.0 (100-1400 F)	2200	2200	Very high oxidation resistance over wide temperature range. Inconel-X maintains spring properties at elevated temperatures.

TABLE I—Properties of typical metals commonly used for brazing fixtures. Generally lower temperatures required for silver brazing produce less oxidation, provide longer fixture life for metal selected. Choice of material is also governed by desired number of cycles per fixture, degree of precision required in parts alignment and cost.

ness, particularly at elevated temperatures; high thermal expansion; high thermal and electrical conductivity; tendency to absorb process heat, and susceptibility to wetting by the brazing alloy.

The properties of some metals used in fabricating brazing fixtures are listed in Table I.

Ceramic Advantages

Advantages of fixture ceramics are: generally superior resistance to oxidation, corrosion and chemical attack; high compressive strength (as supports); low expandibility; dimensionally stable throughout service life; low heat absorption; refractory properties increase heat efficiency; excellent electrical insulator; nonmagnetic; good to excellent resistance to wear and thermal shock; high hardness; resistance to wettability by the brazing alloy; wide range of forms and shapes.

Limitations of ceramics: difficult to machine (with a few exceptions); fair to poor impact strength; somewhat higher initial cost compared with metals (except possibly the castable types).

In fixturing for furnace and automatic machine-burner brazing:

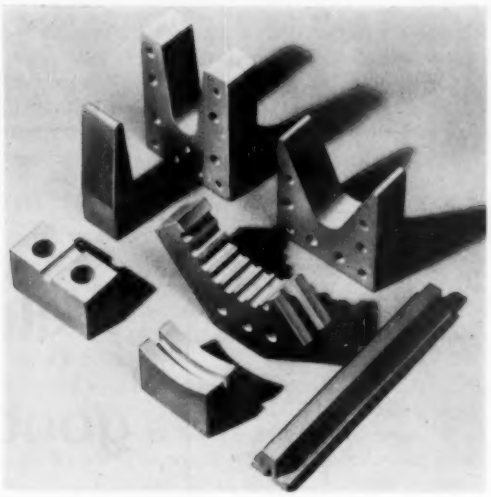
1. Strive for *point* or *line* support of workpieces rather than surface support to minimize heat transfer from work to fixture. Pins, V-blocks, edge constructions and buttons are useful means of reducing heat conduction. The benefits are twofold—less fixture heating and faster part heating (reflected in shorter heating cycles and lower fuel consumption.)

Thin But Strong

2. Grip or support the workpiece as far from the heating zone as possible. Never clamp the workpiece so tightly that parts being brazed cannot adjust for thermal expansion or movement into position when the preplaced silver alloy melts. Gravity and dead weight provide the best possible means of maintaining required pressure on parts.

Cams, clamps or lever systems, however, are sometimes used. Springs are not recommended, unless well out of the heat zone, because they lose temper with alternate heating and cooling.

3. Use as little mass in the fixture as possible, in order to dissipate heat rapidly and to prevent the fixture from absorbing heat from the assembly. Optimum construction will present the thinnest fixture members and sparest design, yet provide adequate support to members and give acceptable fixture life under alternate heating and cooling.



VARIETY of ceramic work-holders for brazing which have been machined from AlSiMag 202.

4. Do not expect infinite fixture life. Consider fixtures to be expendable. Design them simply so that every part of every fixture can easily be replaced with an inexpensive part.

5. If welded designs are used in assembling multiple-piece fixtures for furnace brazing, be sure welds are carefully stress relieved. Otherwise, use bolted constructions. Provide extra clearance in all bolt holes—for fixture adjustability and thermal expansion. Avoid lock washers which lose temper under heat. Use nut-and-bolt assemblies rather than tapped holes in fixture members.

Use dissimilar metals wherever possible (for example, stainless bolts to assemble low-carbon steel fixture parts) to minimize freezing and to simplify disassembly for maintenance. Provide expansion gaps or bolt-slots in large fixture members—for example, construct rotating ring-type work tables in segments.

No Universal Fixture

6. Check fixture dimensions—especially where they touch or come close to the workpiece—so that relative expansion between part and fixture does not cause binding, and so that stray flux build-up on the fixture will not affect fit. Design fixtures for dimensions and tolerances required under heat.

7. Don't try to adapt one fixture to a great many different parts or assemblies. The expense, trouble and complication of trying to develop a universal fixture generally exceeds total cost of individual fixtures for each different assembly—unless runs are short.

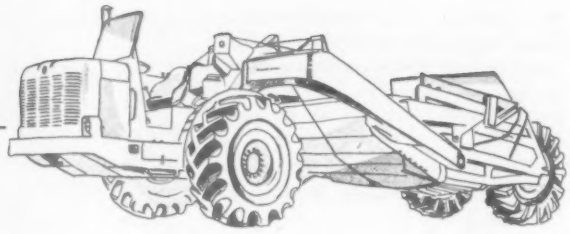
8. Hot combustion products from gas burners are copious and must rise. Accordingly, allow plenty of open space around the workpiece, through the fixture itself and above each heating station. Never use horizontal plates above the burner level unless specifically intended to direct hot gases to a hood, flue or heat-dissipation space. Such plates should be of asbestos composition.

9. Three elements in the design of the heating pattern, machine and process cycle—spreading the heating zone, removing the workpiece from its fixture before quenching, and rotating work during the heating cycle—will generally help reduce fixture problems, increase fixture life and improve workpiece heating.

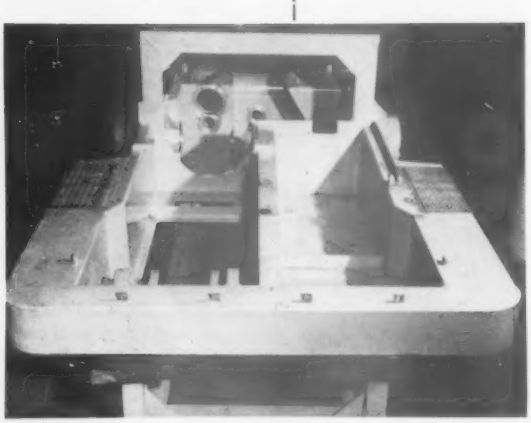
To produce rotation, avoid using gears. Use sprocket-and-chain spindles, friction drives or pulley-and-cable arrangements since these devices are less affected by scaling under heat than are gears.

10. When protection of the fixture from aggressive heating becomes critical, asbestos composition plates (with air spaces behind them) can be used as baffles, and directing cold air blasts on or around critical fixture and machine parts may be helpful. Low-cost ceramic bases or supports for metal fixtures can sometimes provide the necessary heat shield.

At Allis-Chalmers:



Welding procedures and good fixtures give top-quality parts



FINAL drive housing and tractor frame weldment for the "TS-360" motor scraper at upper right. It has been stress-relieved, shot-blasted, machined, painted, and is ready for assembly.

By F. T. Tancula

MORE OFTEN than most of us care to admit, fixturing for welding is the difference between good and bad welds.

Leaving little to chance (and free-hand welding), the Cedar Rapids Works of Allis-Chalmers makes use of an elaborate fixture program to fabricate its road-building equipment. Even the smallest sub-assembly is fixtured for welding.

All welding at the Cedar Rapids plant is of three types —manual arc, semiautomatic submerged-arc and automatic submerged-arc. The main fabrication tool—welding—has been in use here since 1932, when the firm was still the La Plant Choate Mfg. Co. It became part of Allis-Chalmers in 1952. The motor-scraper, tractor and wagon units built here are examples of heavy welding at its finest.

Passing through the tool room, a visitor can see the complexity and enormity of some of the fixtures being built for the assembly line.

Tool Engineering is responsible for designing the tools and fixtures according to Planning Department's specifications. Fixtures are hand welded by the arc process.

Welding power sources at the Cedar Rapids Works are either a-c transformer, a-c/d-c transformer rectifier, or d-c motor generator types. Although primarily an a-c shop, the plant makes wide use of combination a-c/d-c welding machines. This enables a weldor at one station to change from a-c (used for manual arc) to d-c (used for semiautomatic submerged-arc) by simply throwing a switch.

The company prefers a-c for hand welding because it helps eliminate arc blow. D-c is recommended on semiautomatic and automatic applications because of its polarity advantages.

For manual welding, the plant usually uses E6013 electrodes, although the new improved electrodes with 30% iron-powder coatings are finding greater applications. Diameter sizes of the various electrodes (the E6011 and E6020 types are also employed) range up to and including 5/16 in. Filler wire used in the submerged-arc method is mild-steel.

Low-Cost Maintenance

The trend is toward combination machines for dual-purpose applications because maintenance costs on space-saving a-c/d-c equipment are at a minimum in comparison with motor-generator equipment. Excluding dual-purpose jobs, the a-c transformer power source is preferred because of low maintenance costs where heavy plate welding is carried on.

Plate thicknesses used in the dirt-moving motor-scraper units range from sheet metal (for grilles and hoods) to 2 in. stock. Although primarily of mild steel, the scraper unit also contains some low-alloy, high-strength steel. For welding the latter, Allis-Chalmers utilizes low-hydrogen, lime-ferritic electrodes—sometimes to tensile strengths of 100,000 psi.

Box-frame construction is used throughout the road equipment for maximum strength. Hardfacing comes into the production picture when cutting edges of some

scraper blades are given a layer of weld metal after being flame-cut. These cutting edges are also heat-treated.

Strength of the Model TS-360 motor-scraper begins in the tractor frame. This frame, of welded box-type construction, supports each component of the power train independently and provides the service simplicity of unit construction.

49½ Tons, Loaded

In each tractor scraper, there are about 1,000 lb of electrodes, as welded. The TS-360 motor-scraper weighs approximately 49,000 lb and, with a full payload of 50,000 lb, weighs roughly 99,000 lb.

The final drive housing is stress-relieved and line-bored for maximum sturdiness, rigidity and true alignment of moving parts. This final drive gear case comprises the greater part of the frame and presents a real welding problem.

Its non-symmetrical design necessitates off-center welding. But stresses that obviously would be present because of this design have been overcome by A-C's strict adherence to a definite welding procedure, as well as by its fixturing program.

Quality Control

As a means of quality control the Cedar Rapids Works utilizes visual, destructive and some non-destructive testing. The non-destructive method usually consists of a magnetic-particle test. Some weld probing and trepanning is employed. Stress analyses are made through use of stress coat and strain gages.

The strict welding procedure mentioned earlier is described to every weldor by numerous means:

(1) Allis-Chalmers uses AWS symbols on all drawings.

(2) Engineering provides blueprints of all sub-weldments, and these prints include all pertinent welding information.

(3) A set of welding specifications goes to each operator.

(4) Lastly, each weldor has at his station a job-instruction sheet for each major weldment.

The foregoing naturally implies the need for a highly qualified weldor. The training program at A-C is an intense one. Every operator, regardless of previous experience, must undergo a 10-hour training course (stretching over six weeks) to learn standard procedures.

Weldors are classified into four groups—A, B, C and D—and to be upgraded to a higher classification, every man must pass the weldor-qualification test for a particular grade. Regardless of seniority, no one is promoted automatically.

Every man who welds with the semi- or automatic processes is a Class A weldor.

From The Ranks

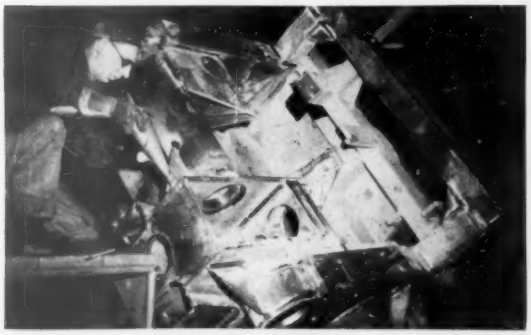
The company tries to develop its weldors from the ranks, and it has often taken a man from a job far removed from welding, trained him, and made him a Class A weldor. This "on-the-job" training is especially important in a city like Cedar Rapids, where competition for the better weldors is always stiff.

To mold a neophyte into a weldor, A-C has a training course that includes several days of classroom instruction. After completing the course, a student is placed on a job in the shop where he remains under close supervision. After 30 days of on-the-job instruction, he is permitted to take welding qualification tests.

If he develops normally, as most do, the new man will go through the regular standardization course before he has been out on the floor three months. In addition to prints, specifications, etc., mentioned earlier, the operator is given a handbook that contains information on plant procedures, explains AWS symbols and designations, types of electrodes, etc.

This training; standardizing procedures; fixtures . . . they all go to make top-quality welded road machinery at Allis-Chalmers in Cedar Rapids.

CROSSBEAM and pedestal sub-weldments are welded before final stage which form scraper main frame.



WELDOR uses semiautomatic process on gear case. Power source is combination a-c/d-c machine. Operator switches from d-c to a-c to weld manually.

GEAR case fixture. Here the final drive housing of tractor frame is tack welded, then moved to trunnion positioner for final joining.

Welded barges deliver ammonia to farm areas

INTERNAL construction of ammonia delivery barge ready for installation of 6 pressure vessels.

Not too long ago, the world was largely dependent upon Chilean nitrate for the fertilizing agent nitrogen. Now, anhydrous—or moistureless—ammonia enriches the soil more thoroughly and much more cheaply. Astronomical consumption of this relatively new fertilizer, however, created a knotty transportation problem. These welded barges may provide an economical solution.

By Thomas J. Dawson
Metallurgist
Ingalls Shipbuilding Corp.
Pascagoula, Miss.

THE SYNTHETIC ammonia industry is a modern chemical wonder. But a chemical age creates chemical problems. The ever-widening use of anhydrous ammonia as a commercial fertilizer has resulted in a need for larger storage facilities and more economical means of transportation.

Designed for marine transportation of anhydrous ammonia are two welded barges constructed for Mid-South Chemical Co. by Ingalls Shipbuilding Co. The barges will service more than 200 storage depots, including large water-side depots at President's Island, an industrial area near the Memphis River; at Harlingen, Texas, on the banks of the intracoastal waterway; at New Iberia, La., and near Peoria, Ill.

BARGE nearing completion in Ingalls shipyard will soon carry 400,000 gal of anyhdrous ammonia to storage depots.

These storage terminals, located in 11 states, require more than 12,000 tons (or approximately 5,000,000 gal) of ammonia to fill their facilities.

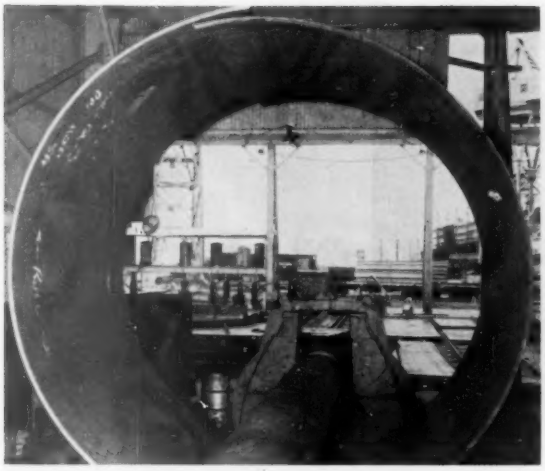
The open hopper barges are equipped with fully X-rayed and specially stress relieved ammonia containers. New remote control equipment is used for loading and unloading. Anhydrous ammonia is pumped with the aid of special pumps, and can be unloaded at the rate of 800 gal per minute.

Pressurized Tanks

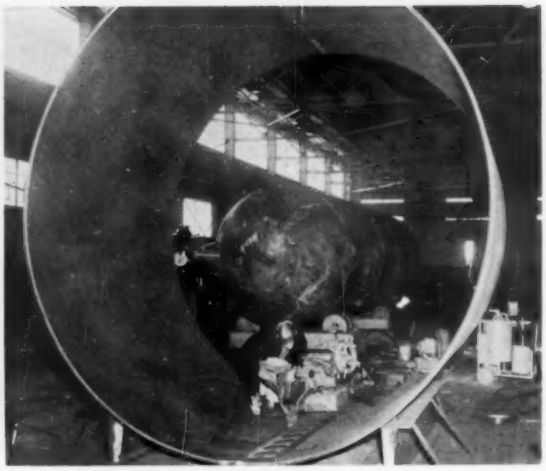
Of all-welded construction, the barges have a battery of six giant pressurized tanks built into their hulls. These tanks have a capacity of 1,000 tons, or approximately 400,000 gal of ammonia.

Each barge has two open hold spaces and two watertight, rake-end compartments formed by collision bulkheads. A watertight transverse bulkhead is installed amidships.

The barges are framed longitudi-



HEAVY low-alloy plates (ABS grade A) for ammonia vessels are formed on pyramid type drop-end roll. Sheet is 1 5/32-in. thick.



SUBMERGED-arc welder makes one of four passes on inside longitudinal seam of tank section. Note completed half-section in background.

nally with transverse web frames and longitudinal trusses between the tanks. Alternate web frames with saddles support the pressure vessels.

Sterns of the barges have a deep transom which is shorter in length than the bow. Installed at the stern are a pair of anti-yawing skegs for ease in towing.

Each barge hull was made into prefabricated sections on platens. Bottom plating was attached to web frames and tank supports. Assemblies were jigged to maintain alignment and get greatest economy from a maximum amount of positioned welding.

Welded Assemblies

For all tacking and out-of-position welding on the barges, E6011 electrodes were used. Downhand butt welds were made with E6020 electrodes, and the E6013 type was used for fillet welding.

To the bottom section sub-assemblies, prefabricated side assemblies and centerline bulkheads were attached. Bow and stern assemblies were welded complete on the platens and lifted into place on the ways for final assembly.

Accuracy required in fabrication of sub-assemblies and in final assembly on the ways can be seen in the fact that alternate web frames, which form support for the pressure vessels, had to form a true line with the skin of the pressure vessels. The web frame construction met provisions for roundness and alignment as strict as those of the pressure vessel code.

Heavy restraining blocks of concrete were used to hold assemblies in true alignment and close fit during welding. Special sequences were applied and carefully maintained to achieve alignment.

A large shipbuilding yard, whose overhead includes heavy facilities, requires semi-production-line operation and relatively ingenious applications of production methods to meet the competition of small barge yards.

Fabrication Economy

These barges were both erected on one building way. Final assembly of pressure vessels was done at the front of the headhouse. Final cleaning and painting of pressure vessel containers, with the application of special protective coatings, took place at the outboard end of the ways before installation into the barges.

The six cylindrical pressure vessels to carry anhydrous ammonia on each barge were constructed in accordance with rules and regulations of the U. S. Coast Guard and the American Bureau of Shipping. The final completed pressure vessels weighed in excess of 60 tons each.

Since this great weight factor would have necessitated two-crane handling of each vessel, they were constructed in halves and finally assembled at the shipbuilding ways. The tanks have 18-in.-diameter manways and all necessary fittings for their service operation.

Pressure vessel heads were measured and matched in pairs. Plates for one pressure vessel were then laid out in accordance with head diameter on an axis that would give true diameter after rolling. This plating thickness ($1\frac{5}{32}$ in.) required a deviation from the center line of the plate, which is the usual axis for a thin plate roll of this diameter.

Welding Procedure

Plates were rolled into cylindrical sections on a drop-end roll which allowed removal of sections onto platen areas. Here, the long seams were fitted and welded inside before being moved back to the fabricating shop.

A 30-deg bevel was made on the inside of plate edges to be welded, leaving a $\frac{3}{8}$-in. shoulder. Both longitudinal and circumferential seams, therefore, formed 60-deg included vee angles and required four passes of the automatic submerged arc welder for completion.

An initial pass was run at 700/750 amp and 28 volts. Amperage was increased to 800/850 for the second pass. This amperage was maintained and travel speed increased for the final passes which topped off the joint.

Vertical Fitting

After inside welding was completed, the outside of all seams were back-gouged. A single pass with the submerged-arc welder, using 900/950 amp and $\frac{3}{16}$-in. wire, finished the outside seam.

Tank fittings, and areas where fit-up was not close enough to be joined by the submerged-arc method, were

TANK sections (left) are fully X-rayed before final seam weld. This joint, too, is then inspected by X-ray and field stress relieved before vessel is installed in barge. BELOW: Completed barge makes big splash as it is launched into Pascagoula River.

welded by manual arc weldors employing E7010 and E7011 electrodes.

Special jigs were used to hold tank heads so that the first section could be fitted into the head in a vertical position. Weight of the round tank segment aided in the close fit-up of this joint.

Once the tank head was welded to the first tank section, four more cylindrical sections were added to form one-half of the full pressure vessel length. This joining operation was done on turning rolls, and special hydraulic jacks aligned shell segments for tacking prior to complete automatic submerged-arc welding.

The submerged-arc welding head was mounted on a gantry type machine for outside seam welding of the vessel sections. Complete X-rays were made of these circumferential welds and they were then stress relieved in a furnace and transferred to the building ways for final assembly.

Special fixtures and turning rolls were set up in front of the building ways for final fitting and submerged-arc welding of the closing seam. The inside seam was joined with a welding head modified to fit through the 18-in. manway. Outside seam welding was done with the submerged-arc welder mounted on a gantry machine. A formed T-bar served as a hold-down strap while welding was in progress.

Final Procedures

With welding completed, the closing seam was finish grinded and X-rayed. A portable, gas-fired annealing furnace was used for stress relieving a band around the vessel which included the final seam weld. Following stress relief, the vessel was moved to the barge for a hydrostatic test before final installation.

Special catwalks on the barges allow access to the collective valve assembly for each of the pressure vessels. The piping system terminates at the central catwalk area into manifolds for remote operation by compressed air.

Loading and unloading is accomplished by a closed piping system with liquid and vapor return lines. Most of the piping is inside the pressure vessels for safety and ease of operation.

After installation of the complete piping system, the barges were launched into the Pascagoula River, ready for anhydrous ammonia delivery service.

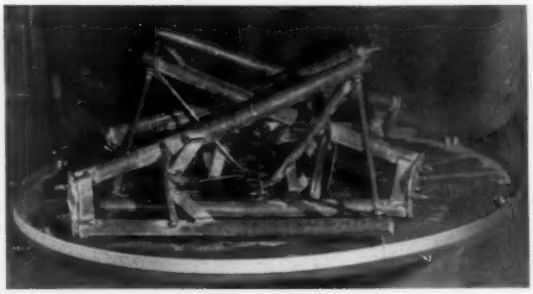
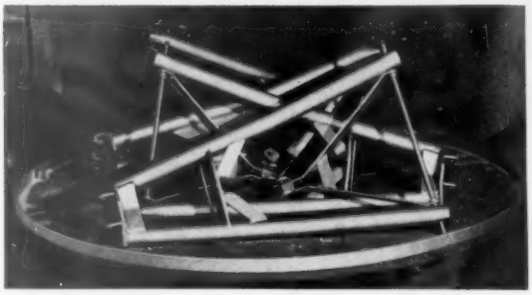


TABLE-load of welded parts is shown in a before-and-after sequence (at right and below) that indicates the thorough cleaning job performed by blast cleaner.

Blast cleaning gives that "clean weld" look



ADOPTION of automatic cleaning procedures for fabricated compounds has resulted in considerable savings for Arps Corp., New Holstein, Wis. Airless abrasive blast cleaning is currently being used to remove scale, slag and spatter prior to painting weldments.

Arps manufactures earth and snow-moving equipment, and individual weldments may weigh a few ounces or 350 lb. Cleaning formerly was done by air tools and grinding, with a vapor degreasing operation afterward to prepare surfaces for paint. Handling problems slowed operations, and the amount of labor required made cleaning operations costly.

A search for other methods to accommodate the varied sizes of products, reduce labor requirements and eliminate intermediate handling steps resulted in adoption of the present automatic method.

In view of the range of sizes and shapes of components to be cleaned, a swinging-table type of blast cleaner was selected. It has an 86-in.-diameter work table attached to the cabinet door to facilitate handling.

Loading by Hoist

When the cabinet door is opened, the work table automatically swings out into the room for loading or unloading. Large and heavy pieces can thus be loaded or unloaded with a chain hoist or lift truck.

For the cleaning operation, the table automatically enters the blast chamber as the cabinet door is closed. The table may accommodate hundreds of small parts, a dozen or more medium-sized ones, or from two to five large weldments at a time.

Airless abrasive blast cleaning is performed by hurling metallic-shot abrasive upon the work. The shot is thrown centrifugally by bladed wheels within the cabinet, and no operator is required during this cycle.

The machine designed for Arps Corp. has two abrasive-hurling wheels, one in the cabinet roof for over-all coverage, and the second set at an angle on one side wall. The latter wheel reaches difficult areas as the work table rotates in the blast. Cast steel shot with a nominal particle diameter of 0.033 in. is used.

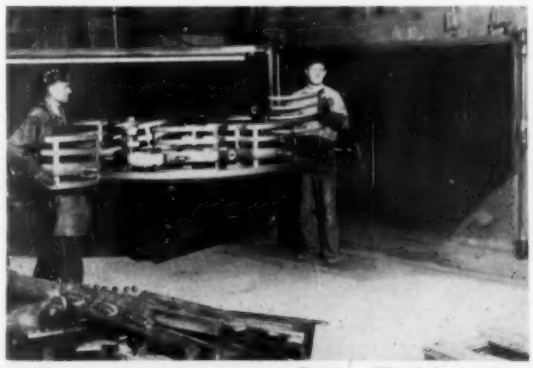
$28,000 Savings

The switch to this automatic cleaning method has netted Arps an estimated cost saving of $28,000 a year. Cleaning is performed rapidly; a maximum time of four minutes in the blast chamber is sufficient for a load of any weldments handled by the firm. The blast cleaner also provides sufficient cleaning-room capacity to handle additional job cleaning.

Labor requirements are low. Workmen are needed only to load and unload the work table. Their attention is not required during blasting.

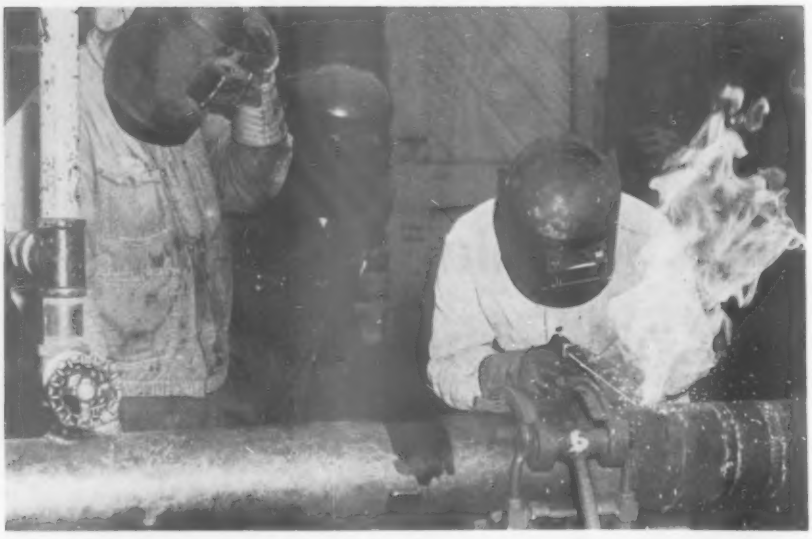
Quality of weldors' work improved after blast cleaning was adopted, because more thorough cleaning helped visual inspectors spot very small imperfections that might otherwise have gone unnoticed.

Paint adheres more firmly to weldments because blast cleaning gives them a matte-type surface. Elimination of all grinding and chipping—with attendant noise and dirt—has improved labor and public relations, and this cause is further served by a dust control unit attached to the machine which prevents air becoming fouled both inside and outside the Arps plant.



—Courtesy Wheelabrator Corp.

WORKERS remove a load of clean parts from blast cleaner. Four minutes is maximum cleaning time needed for any part at Arps Corp.



FIELD emergencies and how to handle them are dramatically brought to life in a special pipe welding class. Under supervision, welding student cuts through pipe holding gas under pressure, then fills hole with weld metal.

PIPE WELDORS:

Middlemen in the growing market for natural gas

THIS weld failed . . .

. . . but this one won't. Classroom instructors demonstrate in a practical way the results of good and bad welding practices. Students are "graduated" only when they demonstrate sound skills with manual arc and oxyacetylene welding equipment.

By Jack Fairlie

In its third year of independent operation, Northern Illinois Gas Co. has long since installed its half-millionth gas meter and is currently operating at top speed to meet the demands of rapid home and industrial construction in its service area.

From headquarters in Aurora, Ill., this former operating subsidiary of Commonwealth Edison Co. furnishes natural gas service to residential, commercial, industrial and governmental customers throughout northern Illinois. Chicago is excluded from this territory.

Welding, quite naturally, plays a key role in the firm's pipeline installations. Both manual arc and oxyacetylene welding are used in construction. (See *On the job* in this issue for a photo of an operation that is scarcely more than routine for Northern Illinois Gas Co. weldors.)

The extent to which welding must be used by the men who operate the many gas service trucks throughout northern Illinois indicates a continuing need for trained and qualified weldors.

This need was foreseen by the gas utility, and is being met in company training classes that periodically graduate employee students schooled in the techniques for manual arc and oxyacetylene welding.

Here is the way these weldors acquire and apply the skills needed for their highly-diversified operations.

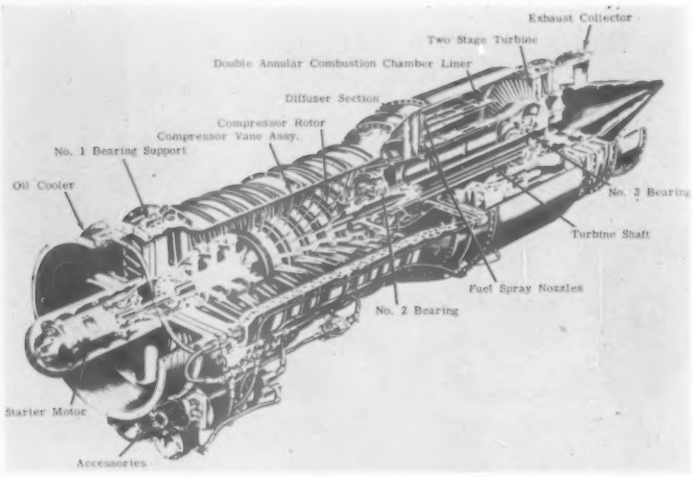
IT can be tough in class . . .

. . . but it's even tougher in the field. Using oxyacetylene torch and ⅛-in. wire, weldor joins 2-in. service pipe in residential area. Old line is left untouched; new pipe is laid over it.

DEEP in a hole, this weldor uses ⅛-in. E6010 electrodes to join ¾-in. service pipe to 12-in. main. Engine-drive d-c welder provides current for this application, which requires three passes for completion. Sidewalks no longer have to be torn up for service pipe installation; workers dig hole beneath them and run pipe through.

WORKING in a new residential area, operator (above) uses oxyacetylene torch and filler wire to weld T-joint to a section of ¾-in. service pipe. At right, workman joins pipe sections which will later be laid in slit trench and joined to main. This weldor may have to join pipe up to 16 in. in diameter.

Design aspects of turbojet welding



CUT-AWAY view shows major components of Westinghouse "J-34" turbojet engine.

By Fred Seaman
Westinghouse Electric Corp.

As THE aviation power plant industry entered the jet propulsion field, the need for efficient lightweight structures caused jet engine manufacturers to place an ever-increasing emphasis on welding processes.

Since those portions of the engine constructed with welded assemblies contain combustion gases, welding activity in the turbojet field has been directed toward joining of stainless steels.

Jet engines consist of a cylindrical air passage, the forward portion of which contains an axial flow compressor. The center portion acts as a combustion chamber where compressed gases and fuel are mixed and burned.

In the after end of the engine frame, a turbine removes some energy from the hot combustion gases (to drive the compressor) before they are ejected from the exhaust collector to drive the plane forward.

Operating Conditions

Conditions which prevail while a jet engine is in operation establish loads which welded joints must carry. A list of happenings which take place each second within the engine may serve to present some picture of stress levels involved.

In one second, a typical engine might:

Take in: 720 ft^3 of air;

Burn: 1 pt of fuel;

Exhaust: 24,000 ft^3 at approximately 1,200 F minimum;

Cause rotor to turn: 210 revolutions.

Passage of this large amount of gas through an engine produces high steady loads on engine elements in its path. Internal pressures acting during a given set of flight conditions also create high static loads. All of these stresses, however, can be estimated and will not vary under any given set of operating conditions.

It is the unavoidable aerodynamic, thermodynamic and mechanical instabilities which create a high level of vibratory loading, ranging in frequency from within sonic range upwards into ultrasonic frequencies. This complex dynamic stress pattern has two marked effects on welding.

First: We have learned to use only those joints which are reliable in *manufacturing* as well as in *service*. There are a number of welded joints which can be successfully produced *if* complex automatic equipment is applied or *if* a weldor is extremely careful and conscientious in applying his skills. Such joints are avoided as unreliable—manufacturing-wise—even though such a joint, properly made, might last indefinitely.

Second: Simple welds, such as butt joints, are considered best for high-efficiency service. They are used at all times in preference to welds where a complex fillet geometry might produce hidden stress concentrations to cause weld failure under vibratory loads.

Weight Limits

It is difficult to explain the awe with which aircraft manufacturers approach a weight increase. This problem may illustrate the importance of weight in producing a satisfactory competitive engine.

Problem: What is the effect of increasing engine weight by 100 lb on a modern fighter plane weighing 20,000 lb?

Answer: Airframe size must be increased 10% if safety and flying ability are not to be sacrificed. This would add 1,000 lb to plane weight and result in an $80,000 increase in the cost of each delivered plane. *These are conservative figures.*

Welded assemblies replace castings or forgings common in reciprocating aircraft engines because machined parts could not be produced with thin wall sections required for maximum load-carrying efficiency.

Secondly, gussets and stiffening straps are avoided where possible, so each weld must perform at a high level of efficiency.

Thirdly, resistance welding overlap is kept to a mini-

mum. This may seem like cutting corners too closely, but removal of ⅛ in. from a large flange may save 2 lb of vital engine weight.

Even small-diameter sheet metal joints may account for a weight saving of ¼ lb for each ⅛ in. of overlap. Many components have 40 or more resistance welded joints, so a slight increase in overlap could account for a large weight increase.

Changing Design Situation

Third in the series of factors controlling design and welding thinking is the constantly changing design situation.

There is keen engineering competition in any young industry, and particularly in industries producing defense materials. But the science of aerodynamics and thermodynamics has not advanced to a point where optimum designs can be produced entirely on paper.

Therefore, in order to produce the best design in various engine components, a development organization is constantly building entirely new or revised components for testing. These components must be produced with a minimum of delay.

As a result of these conditions, design engineers and the manufacturing staff must handle well over 100 drawing changes each week. In order to make the best of the situation, development shops have:

(*a*): Standardized on the most flexible types of welding equipment. Reliable universal equipment is usually favored over limited application automatic equipment.

(*b*): Learned there is no place in a development shop for welding specialists trained to make only one joint. Many welding situations are unique, and there are no practice joints available for the weldor.

(*c*): Learned that successful designs are those making greatest use of standard joints. In this way, even though the component is vastly different from all previous components, the weldor's portion is familiar to him and compatible with his skills.

Materials Used

Two of the three common classes of stainless steel, the austenitic and martensitic grades, are used in jet engine manufacture. In selecting AISI 321, 347 and 310 alloys (austenitic), oxidation resistance, critical material content and high-temperature strength have been of prime concern.

(These alloys are characterized by low yield strength when this value is compared to ultimate tensile strength. Also, these austenitic grades cannot be heat treated to gain more strength.)

The 347 grade must be stabilized with columbium to retain corrosion resistance during exposure to temperatures from 900 to 1,600 F. A shortage of columbium has recently forced manufacturers to switch to 321 alloy, which is stabilized with titanium.

Fewer Weak Links

After considerable experimentation, there seems to be no difference between 321 and 347 alloys as far as welding is concerned. This is a contradiction of earlier experience where large amounts of non-metallic constituents in the alloy reportedly resulted in spot weld expulsion and cracks in arc welded joints.

For joining austenitic alloys, the 347 and 349 grades of arc welding alloys are used. Their controlled ferrite content lessens the chance for formation of "weak-link" patches of low-melting constituents.

When these alloys are used in the form of coated welding electrodes, an extruded lime coating is preferred. This is not a mandatory preference. The choice was based on a review of: (*1*) the difficulty of handling very small electrodes with uneven dipcoats, and (*2*) an observed tendency on the part of titanium coatings to produce porosity and cracks to an extent which overbalances their ability to form more uniform fillets than lime-type electrodes.

The use of electrodes with low-hydrogen coatings for joining hydrogen-sensitive stainless steels has brought with it a sharp awareness of the need for a moisture control program prior to electrode use.

Under this program, electrodes are stored in a dry place; tool room attendants are instructed to open only one package at a time; tool rooms are equipped with ovens to keep open packages dry, and weldors procure only material needed for a job at hand.

Deformation Resistance

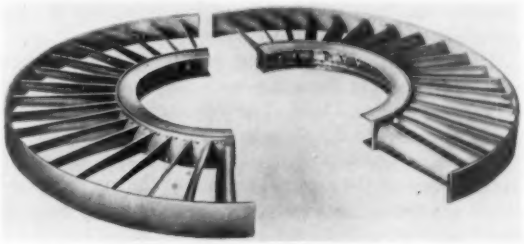
It is not surprising that some physical characteristics of austenitic alloys also show themselves in resistance welding. Resistance of these alloys to deformation at high temperatures requires welding equipment that maintains a very close relationship between current and pressure applications. For this reason, synchronous controls are always specified.

Welding pressures required are higher than those used on low alloy steels. This gives rise to a problem in securing equipment where large fabrications are involved since the lower arms of standard resistance welding machines are not large enough for the high pressure involved.

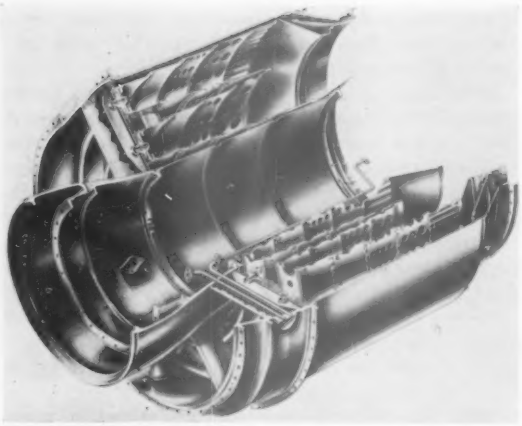
Hardenable grades of stainless steel are straight chromium-iron alloys and, when compared to austenitic materials, are much less stainless. They have very good strength to about 1,100 F and are sensitive to heat treatment, so welding produces a brittle transformation zone along the welds. For this reason, all joints must be stress relieved to make them useful under imposed design conditions.

This stress relief must be carried out as soon as possible after welding. There is a metallurgical reason behind this requirement because of high stresses tied up in the hard transformation product.

The main reason, however, is to avoid accidental bending of the extremely brittle weld in handling. This



HARDENABLE stainless steel is used in this vane assembly. Many welded vane-shroud joints make up the heart of a jet engine, and all must be highly accurate and strong.



DIFFUSER and combustion chamber assembly contains many flanged cylinder weldments. Hard-to-weld corrugated spacers are spot welded into combustion liner assembly.

would be undesirable if spot welded joints were broken. These joints can be examined from the outside only, and no indication of failure would be evident.

A Matter of Balance

In contrast to hardenable alloys, heat treatment of a number of non-hardenable austenitic steels is a matter of balancing the *need* against the *difficulty* of heating and cooling large, light sheet metal assemblies.

One common use of heat treatment is to stabilize the part, which is fixtured at required dimensions and heated above its operating temperature to let manufacturing stresses equalize.

Critical joints in austenitic alloys which are heavily loaded must be stress relieved. Determining which of these joints requires heat treatment is difficult. Since no gross metallurgical change occurs along the weld, there are no metallurgical reasons for stress relief.

This is further complicated by the fact that it is difficult to predict the stress level which may be arrived at during welding of the part. The choice, therefore, is made either by experience with a previous part or by weighing the effect of several factors: rigidity, ratio of weld to base metal, and percent of efficiency required.

Engine Components

An illustration accompanying this article shows a cutaway section of the diffuser and combustion chamber of a typical jet engine. It indicates two of the three basic fabrications from which the engine is made: flanged cylinders and corrugated weldments.

Flanged cylinders are light metal sheets rolled and welded by the Tig (tungsten inert-gas) process to form cones or cylinders. Light, close-tolerance flanges are then seam welded onto the cylinders.

Finally, a number of brackets and bosses are resistance welded on the external surface of the assembly and struts are welded on inner portions to hold the rotor in position.

These parts must meet exact dimensional requirements because they are interchangeable from one engine to the next. They must also *accurately* direct large volumes of rapidly moving gas or air. Should balance be disturbed, hot gases would melt through the light sheet metal walls within a few seconds.

Also illustrated is a combustion liner designed around the corrugated cylinder, the second basic fabricated construction used in the aviation gas turbine. This part has the same limits of interchangeability imposed on flanged cylinders.

Handling Combustion

It plays an even greater part in handling the destructive forces of combustion while maintaining maximum thermal efficiency as compressed air is passed through it at 330 mph. The combustion liner is constructed of sheet metal cylinders, each about ½ in. larger in diameter than the next, and fastened to each other (through a spot welded joint) by a narrow corrugated cylinder.

The corrugated weldment is a good example of an operational requirement taking precedence over good welding design, and placing the burden of producing the part on the manufacturing dept.'s ingenuity. However, resistance welding of these corrugated cylinders can also be cited as an example of a difficult job made easy by proper process control.

Early manufacturing experiences were built around weldor skill. Recently, increased effort has been directed toward better control of welding conditions (*i.e.* current and electrode configuration) so that carefully prepared standard schedules may be used. Some unpredictable elements of operator skill are thus eliminated.

Stationary vane assemblies form the third and final major fabricated component group used in the design of aviation gas turbines. These welded assemblies, which must efficiently direct air through the rotating elements, comprise a vital portion of the heart of a jet engine.

The relationship of the vane to the flow of air must be maintained within a few angular minutes. Closeness of whirling blades and rotor requires that assembly diameters be held to a few thousandths of an inch, and that vane edges form an almost perfect plane.

Important Tig Weldments

Just as corrugated and flanged cylinders accounted for the major portion of resistance welding on the engines, these vane assemblies are the most important Tig (tungsten inert-gas) weldments.

The third illustration shows a typical compressor vane assembly, consisting of an outer shroud and an inner shroud with vanes extending between them. Both shrouds have carefully located holes punched through them at equal intervals to receive ends of the vanes.

Vanes have an airfoil cross-section, somewhat like an airplane wing, and are notched at either end so the thin leading and trailing edges are removed. A peg is thus left at this location and it is just long enough to extend through the punched hole in the shroud. Welding is done from the outer end of the peg.

Tig welding equipment is used with very little filler rod. Both shrouds are made of hardenable stainless steel and are heat treated after welding to anneal joints. Vanes are stabilized austenitic stainless steel.

Preforming of shrouds, controlled weld sequence, and careful fixturing have been used to overcome effects of an abnormally high weld-to-base-metal ratio; the complex airfoil-shaped joint, and a highly restrained welding condition.

Careful welding allows wide use of 430 stainless

The authors performed the welding tests which resulted in this up-to-date report. Mr. Goodford is chief welding engineer, and Mr. Loria is staff metallurgist, at Crucible Steel Co. of America, Harrison, N. J.

By J. A. Goodford and E. A. Loria

Lack of availability of corrosion-resisting steels containing nickel for many commercial applications has been a serious problem to users and manufacturers for a number of years.

Substitutions of straight chromium steels have been made with appreciable success and type 430 stainless is one of the more popular grades in this category. However, while this material has been an effective substitute and is satisfactory for many applications, it has presented some fabrication problems where welding is required. This is due to the steel's susceptibility to grain growth and embrittlement when subjected to temperatures around 2,000 F.

These high welding temperatures develop a coarse crystalline structure in the weld area, affecting both ductility and corrosion-resistance properties of the welded structure.

Although 430 is essentially a ferritic type, welding temperatures cause a portion of the ferrite to transform to austenite. Upon cooling from high welding temperatures, some of the austenite transforms to martensite around the ferrite grains.

Resistance Restored

Constructive observations and development have resulted in precautionary measures which minimize embrittlement problems, restore corrosion resistance, and expand potential satisfactory applications of welded construction.

Corrosion resistance of the welded structure can be restored completely by postheating the material to 1,375-1,475 F (normally 1,450 F), followed by rapid cooling with air blast or water. Some ductility is also restored by this practice.

In order to restore maximum mechanical properties of the welded structure, the weld should be peened at elevated temperatures (generally temperatures around 1,000-1,500 F). After peening, the metal should be reheated to 1,450 F and quenched rapidly to room temperatures.

This procedure may be impractical for most light-gage fabrications, because warpage will result and the majority of fabricating plants are not equipped to perform the required heat treatment. Where maximum quality of the welded structure is a prime requisite, however, the peening procedure is necessary.

Peening can be performed at preheat or room temperature. If done at room temperature, care must be taken to avoid excessive peening that could crack the weld.

Austenitic Electrodes

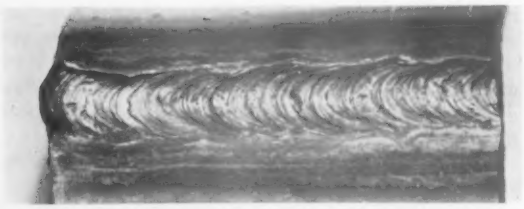
When it is not feasible to postheat after welding, austenitic chrome-nickel electrodes should be used where permissible under customer's specifications. Austenitic electrodes create the best mechanical properties in the welded structure because the weld bead remains essentially austenitic and ductile.

The ductile weld provides a cushioning effect for enlarged grain structure in the heat-affected zone. Consequently, the welded area will withstand more shock and stresses in the as-welded condition.

The following grades of austenitic electrodes may be used: types 308, 308LC, 309, 310 and 347. Normally, type 308 will suffice.

This method, however, will result in a line of demarcation when the surface is ground and polished. The austenitic weld will polish up brighter than the parent type 430 material. Further, a line of demarcation is not confined to austenitic welds.

It also becomes apparent when employing 430 coated electrodes and other welding processes. The line of demarcation can be eliminated by methods to be described except on welds made with austenitic filler metal.



TOP: Specimen of a weld in type 430 stainless which was heated to 1,450 F, water cooled, and bend-tested to a 70-deg angle without fracture. BOTTOM: Similar weld, not postheated, fractured at juncture with parent metal after air cooling and a 30-deg bend.

The 430 Electrodes

When it is necessary to employ type 430 coated electrodes, it is advisable that the work be preheated and postheated, particularly on 11-gage material and heavier. Preheat at a minimum of 300 F prior to welding and maintain not less than 250 F during welding. Postheat should be 1,375-1,475 F with air or water cooling.

This heat treatment will not refine the grain structure. It will restore some ductility and will also give the welded structure a corrosion resistance equal to its former state.

Here again, on polished surfaces, a line of demarcation will be apparent, for the weld will be duller. This is due to enlarged grain structure caused by welding temperatures.

Color matching can be effected by peening the weld at elevated temperatures. If a high temperature is not feasible, peening at preheat or room temperature may be employed. Care must be taken that welds do not crack, which may occur when peened excessively at room temperature.

Titania-Coated Electrodes

It has been found that titania-coated electrodes render more uniform grain size in the heat-affected zone than lime-coated electrodes.

Lime-coated electrodes produce a heavy slag ahead of the molten weld puddle, particularly in light-gage welding. This slag interferes with travel speed to the extent that the operator may have to retard his speed even further to brush away accumulated slag.

Such momentary hesitation allows arc heat to build up, causing grain structure to enlarge further. This develops more embrittlement and weakens the structure at these points.

Mig and Tig Welding

Titania-coated electrodes have no undesirable slag interference. Thus, they permit uniform travel speed, which renders more uniform grain structure and ultimately results in less grain growth.

The Mig (metal inert-gas) process requires filler metal and is generally used on thicknesses of 3/16 in. and heavier. A degree of success has been realized when this process is used with austenitic (chrome-nickel) and 430 filler wire. In all cases, preheat and postheat is advisable. If postheat is not feasible, at least a preheat should be used.

The Tig (tungsten inert-gas) process is generally employed for light-gage welding without the use of filler metal and heat treatment.

Where adaptable, however, austenitic tack welds are advisable for the 430 material. These austenitic tack welds are ductile and consequently aid in effecting a stronger welded structure.

Where Tig is employed on gages of thicknesses requiring 430 filler metal, it is advisable to use a minimum preheat of 300 F and postheat of 1,450 F. If postheat cannot be performed, preheating should be a minimum requirement.

Here again—with or without filler metal—a line of demarcation will be apparent on polished surfaces for the weld will be duller. Complete matching can be effected by peening the weld at elevated temperatures. Peening refines the grain structure necessary for blending purposes.

Should peening at high temperature be impossible, preheat or room temperatures can be used if precautions are taken against excessive peening that can crack the weld.

Oxyacetylene Welding

Oxyacetylene welding is not generally recommended for welding type 430 stainless. More time is needed to raise the temperature to required melting point of the steel than with other processes. The result is excessive grain growth and larger extension of brittle areas.

A great deal of interest has centered on the 430 Ti grade (modified with titanium), particularly in respect to improved mechanical properties in the as-welded condition.

While experience indicates that mechanical properties of the structure are improved due to a lower tendency for grain growth under welding heat, corrosion resistance in the as-welded condition is no better than in the straight 430 grade.

The only significant difference is that the band of corrosion attack in the heat-affected zone is considerably narrower. In order to restore full corrosion resistance, it is necessary to subject the material to a 1,375-1,475 F postheat and rapid cooling to room temperature. Peening for this grade is also beneficial.

Where parent metal cracking may be encountered on severe bending of 430 and 430 Ti, the use of infrared lamps at temperatures of 300-500 F is very beneficial in rendering quality bends. Subjecting parent material to boiling-water temperature prior to forming is also helpful.

When a weld seam is subjected to a severe bending transversely across the weld, cracking normally will occur. A local preheat of 300-500 F at the weld will improve bending quality of the welded structure.

The preceding data do not lead invariably to the conclusion that all type 430 and 430 Ti jobs must necessarily be handled in the preheat, postheat and peening steps outlined. Many jobs in the as-welded condition will be satisfactory *for those applications where little stress or impact are involved.*

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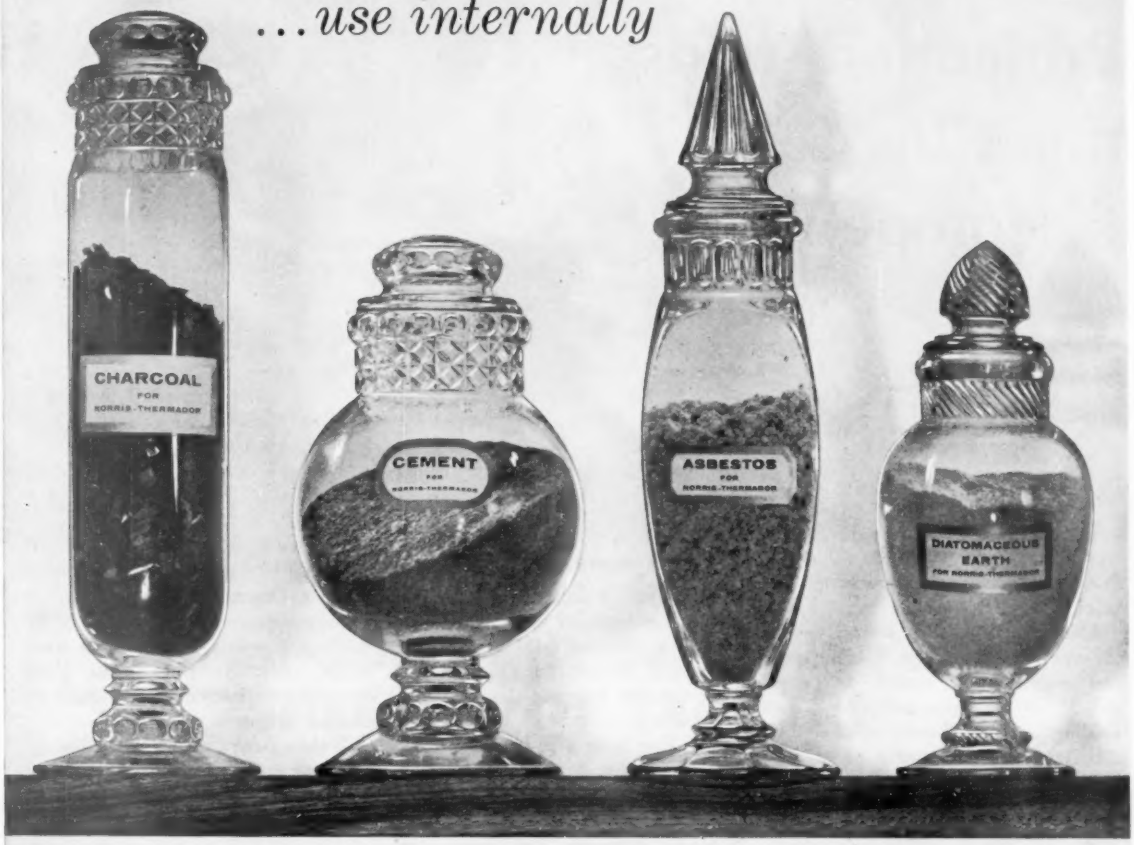

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In fabricating television and radio components . . .

Projection welds meet the test of competition

PROJECTION welder joins bracket to car radio housing. Punch press in background will bend housing after weld cycle.

By Jack Fairlie

AN ATMOSPHERE of growth and productivity reflects Motorola Inc.'s solid standing among the "Big 4" television, radio and electronic equipment manufacturers. But success hasn't prevented the Chicago firm from constantly assessing its fabrication techniques.

Many metal-joining methods—all of which must be both functionally and economically sound—are employed by the firm, and projection welding is a continuing choice for both television and radio parts applications.

Illustrated with this article are two uses for this resistance welding process at the Motorola parts manufacturing division. This division, operating independently of the parent organization, must bid on a competitive basis with other fabricating shops in the Chicago area for all Motorola jobs.

FOUR projections on small bracket are welded to TV tube-mounting strap. Operation is 10% faster than manually-positioned spot welding application.

50% Increase

Projection welding, in one instance, has replaced spot welding in joining a 16-gage, lead-plated, cold rolled steel bracket to a 22-gage automobile radio housing of the same material.

Changing from a 75-kva spot welder to a similarly rated projection welder, and employing a parts positioning fixture of their own design, Motorola engineers have succeeded in raising housing output by 50%.

Coupled with the welding application on this radio housing is a bending operation. A 5-ton punch press, mounted alongside the projection welding machine, folds one end of the housing slightly just after the welding cycle. The combined operation takes but a few seconds.

The projection welding machine, operated by a foot pedal and microswitch arrangement, has a squeeze time of 8 cycles, hold time of 4 cycles, and weld time of 7 cycles. Heat control is 90 cycles.

Vapor Degreasing

The plated housing and bracket are degreased by vapor before welding, as are a television tube-mounting strap and the bracket which is welded to it. The tube-mounting strap is 20-gage cold rolled steel; the bracket, which contains four projections, is 18-gage material.

This operation has also been converted from a spot to a projection welding application—this time with a 10% increase in productivity. With the former machine, the four areas to be welded had to be manually positioned.

The machine in which the bracket is joined to the strap is also rated at 75 kva. Depending upon production requirements, this welder may be run continuously through two work shifts daily. As yet, it has given Motorola maintenance personnel no serious problems.

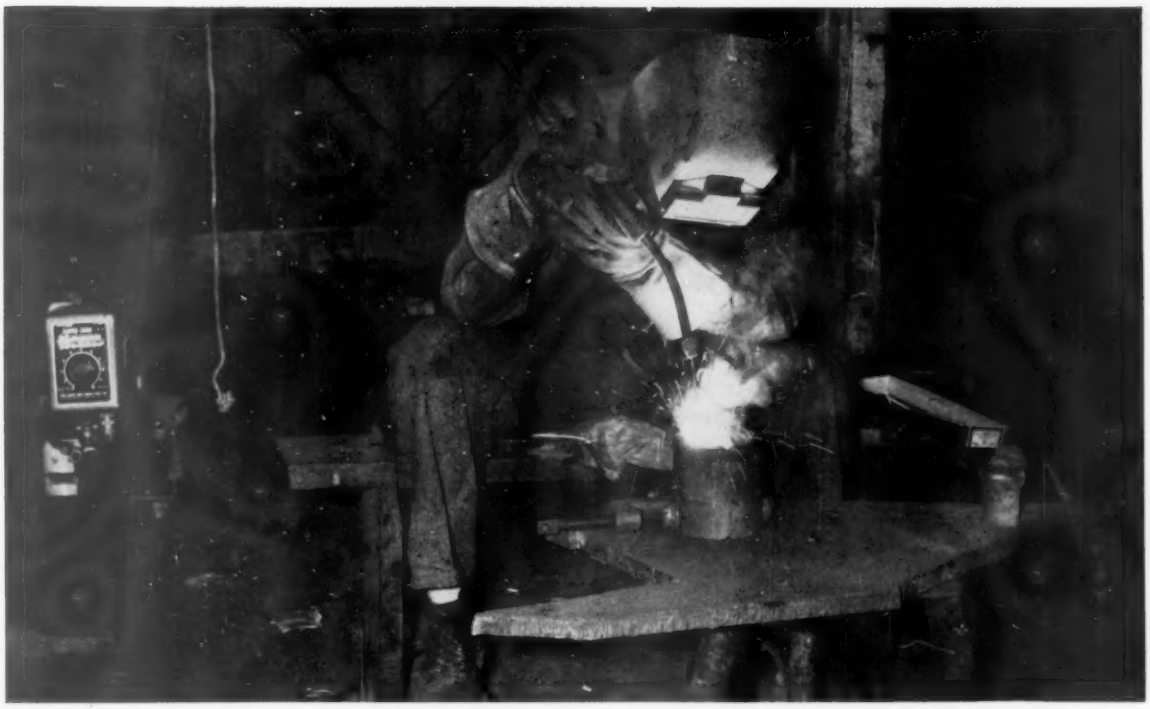
Welding requirements for this application include: weld time, 8 cycles; squeeze, 17 cycles; hold, 6 cycles. Heat control, again, is 90 cycles.

Testing Methods

In both instances, production weld samples are given both visual and destructive tests continually throughout the work day. At half-hour intervals, inspectors remove radio housing and TV tube mounting straps at random for a combination peel-bend test.

Results of this test are not measured in ultimate tensile or yield strengths since neither component will be subjected to heavy stresses—or even significant weight—when put in use.

As a competitive joining process in a highly competitive industry, projection welding has proved itself an integral component in Motorola's production line. It has speed, economy and ease of operation to suit either normal or accelerated fabrication needs—and there is little more that can be asked of any production joining process.



Semi-Automatic Rebuilding of SHEEPSFOOT TAMPERS

A novel idea for salvaging sheepsfoot tampers, with a saving of 45% in cost and 50% in down time, originated with Dave Moodie, master mechanic of J. A. Thompson and Son, large West Coast contracting firm.

As routine maintenance procedure the 220 individual tamper boots on each of the 24 compactors operated by this firm were manually hard-faced until recently in a circle-and-cross pattern; the tamps lasted three or four months before a loss of gauge made them no longer usable. In an eight hour shift the maintenance weldor could manually rebuild and hard-face 18 worn tamps.

Since the firm installed a semi-automatic welder adapted to the use of Stoody 7/64" wires, the picture has altered completely. Today the weldor, using Stoody 121, *rebuilds 70 worn tampers in a single shift!* Mr. Moodie's procedure employs "weld-casting" of the wearing face, using a split carbon mold of the correct finish dimensions. Stoody 121 is applied by the semi-automatic welder, with the mold shaping the large puddle to produce a hard-faced wearing surface of the required depth and gauge.

The rebuilt tampers hold their size twice as long at a considerably lower cost than hard-faced standard replacement boots. Material and labor are approximately $1.25 each for the rebuilt tamper.

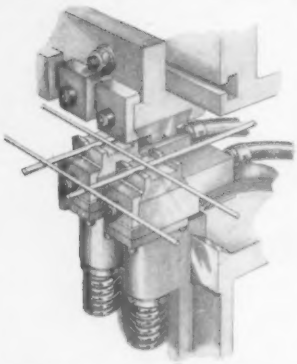
You will find many suggestions for prolonging the life of all types of heavy equipment in the Stoody Guidebook. Your Stoody dealer has a copy for you. Look him up in the "Yellow Pages" of your phone book or write direct.

More speed, easier build-up and automatic sizing are obtained by this carbon mold clamped around the sheepsfoot tamper. Stoody 121 wire is applied semi-automatically.

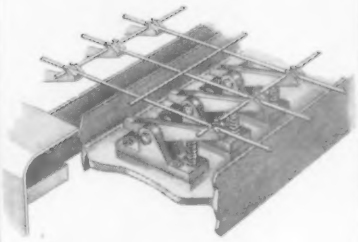
Mold is machined to correct size, grips stem tightly to hold weld metal on wearing surface.

Notice how gauge is still held after 4 months service. Impact strength of Stoody 121 withstands repeated blows of twelve pound sledge used to seat and align tamps during installation.

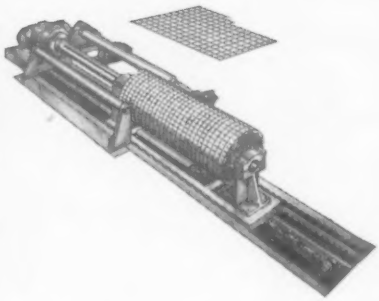
STOODY COMPANY
11941 East Slauson Avenue
Whittier, California



UNITIZED CONSTRUCTION of welding heads simplifies adjustment for mesh spacing and facilitates removal for maintenance. Up to 160 heads may be used.



FEEDER FINGERS advance the fabric between each series of welds. Position of the two sets of fingers is adjustable to suit the mesh spacing.



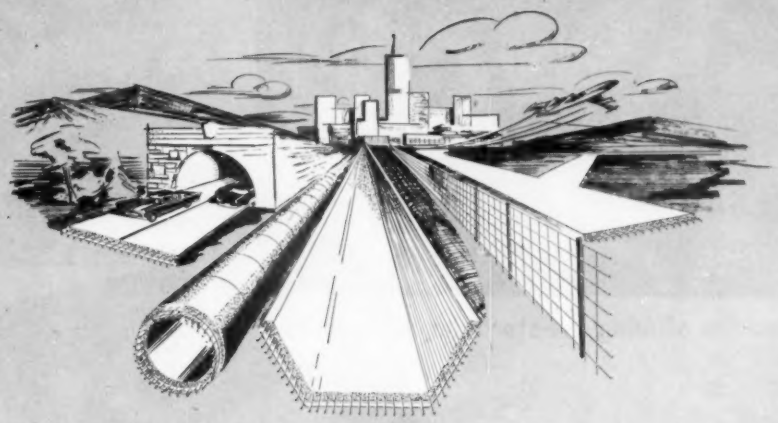
COIL UNLOADING is automatic. A full coil is shown moving out on the cradle which is designed for rapid unloading to permit continuous operation of the welder.

THE THOMSON WIRE FABRIC WELDER

turns out a mile of fabric every 90 minutes. Longitudinal wires are taken from coils, straightened in two directions, and fed to the welding station. Transverse wires are taken from a coil, straightened in two directions, fed into receivers, cut to length, positioned in the welding dies by "placer fingers", and welded at each intersection. "Feeder fingers" automatically advance the fabric through a selvedge trimmer and through the shear or to the coiler.

EVERYDAY USES OF WIRE FABRIC

Welded wire fabric is used to reinforce concrete highways, streets, sidewalks, floors, roofs, walls, beam wrapping, airport runways, pipe, irrigation canals, aqueducts, reservoirs and similar construction. It is also used as fencing, ranging from farm and lawn fence to poultry netting; for flooring, caging, partitioning and grillwork; and as the wire fabric component of many familiar products.



RESISTANCE WELDING
by the mile

An Example of Automation in the Production of Welded Wire Fabric

To supply the nation's appetite for welded wire fabric, Thomson has developed automatic welders which literally produce fabric "by the mile".

The giant fabric welder pictured here makes heavy concrete reinforcement. It turns out over a million square feet a week in widths from eight to sixteen feet in a wide variety of mesh spacing and wire gauges.

It takes the raw material in coils just as it comes from the steel mill and delivers the finished product in rolls or sheets. Rolls are mechanically off-loaded and sheets are automatically sheared into mats of specified lengths.

The Wire Fabric Welder is one of many types of special purpose welders for which Thomson is the recognized source throughout industry. It is also a fine example of automation applied to resistance welding.

A Thomson man will be glad to discuss with you ways to reduce or eliminate work handling in your resistance welding operations. Here is an area in which you can enjoy the advantages and economies of automation *right now*.

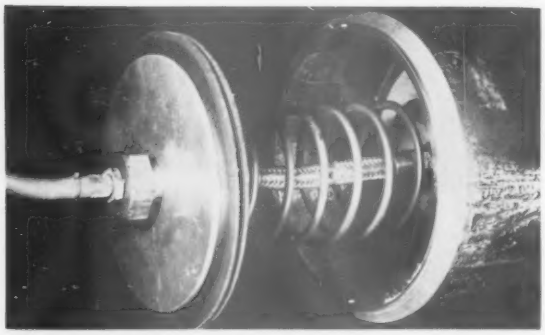
FOUNDED IN 1886 BY ELIHU THOMSON

INVENTOR OF RESISTANCE WELDING

THOMSON *Welders*

THOMSON ELECTRIC WELDER COMPANY, LYNN. MASS.

Thomson also makes a complete line of standard spot, projection, seam and flash-butt welders. Also, aircraft, brake shoe, shell and other special purpose resistance welders.



TYPICAL purging fixture inserted into pipe section. Such fixtures minimize amount of inert-gas required for purging.

Besides offering greater over-all flexibility . . .

Insert rings help prevent root-pass weld cracks

By Helmut Thielsch
Metallurgical Engineer
Grinnell Co., Inc.
Providence, R. I.

IN RECENT years the Tig (tungsten inert-gas) welding process has been applied in an increasing degree to the root-pass welding of piping of wall thicknesses exceeding approximately ¼ in.

The balance of the weld groove is usually completed by manual arc welding with conventional coated electrodes. This practice has been extensively followed on stainless steel piping where quality welds are desired.

Unfortunately, early enthusiasm for this process has been somewhat dampened by cracking difficulties in the root pass. In many cases, cracks in the root pass can be discovered by visual, dye-penetrant and/or radiographic inspection.

Undetected Cracks

Occasionally, however, a crack does not reach the surface of the root pass and cannot be detected by visual and dye-penetrant techniques. It may even "zig-zag" enough to defy radiographic inspection.

For obvious reasons, such undetected cracks represent severe stress raisers which, in critical pressure applications, may lead to further cracking and ultimate failure.

To avoid formation of these dangerous undetectable cracks, welding techniques and procedures must be used which: (1) provide easy welding conditions to minimize effects of human variables; (2) give the most favorable weld contour to resist the cracking tendency of shrinkage and hot shortness, and (3) produce the soundest possible weld metal composition of desirable strength, ductility and toughness.

The best technique to produce root-pass welds of highest quality includes the use of consumable insert rings of proper composition and dimensions.

Acceptable Welds

In fact, in stainless steel piping for atomic reactors, where weld joint perfection is of utmost importance, governmental agencies responsible for applicable welding specifications feel that acceptable welds can be made *only* with consumable insert rings.

The most obvious advantage of a consumable insert ring is greater flexibility. Degree of flexibility is actually higher than that which is considered sound practice when welding without insert rings.

Even with this greater overall flexibility, certain procedures provide consistently better results than others. These procedures represent good welding practice under normal shop or field welding conditions, and can readily be followed by weldors with arc-welding experience.

Economical aspects are also considered. It must be recognized, however, that modifications of these procedures may be desirable for a particular material or materials.

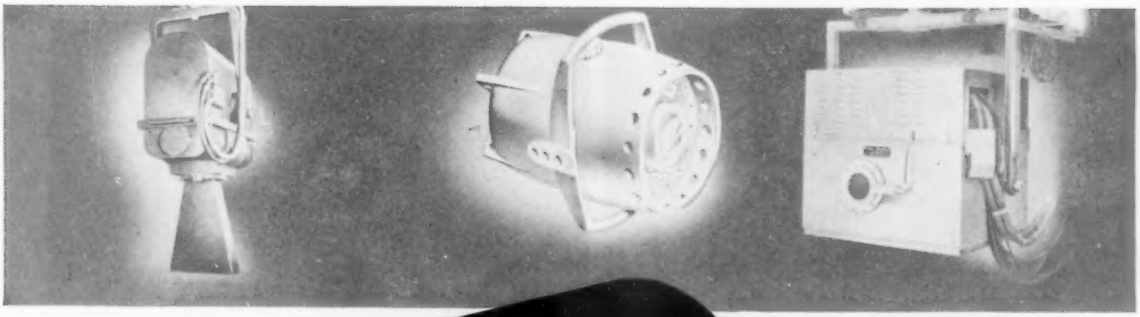
Joint Designs

Ideally, the so-called flat-land root-pass joint preparation would be preferred on all piping with wall thickness over ¼ in., particularly where weldors with little experience are employing Tig welders.

Other joint preparations similar to a U-bevel preparation also may be used. They may give consistently good results when welding is done with experienced weldors, and on materials considered not too susceptible to root-pass cracking.

Sometimes fittings, valves or piping may be furnished with single V-bevel preparations, and although it would be desirable to remachine the V-bevels to a flat-land bevel design, it may not be practical because of increased costs.

Where experienced weldors are used, it may be permissible to make a joint consisting of a V-bevel and a flat-land bevel on carbon and many alloy steels. Where a V-bevel is joined to a flat-land bevel, the welding torch should be inclined slightly toward the V-bevel.



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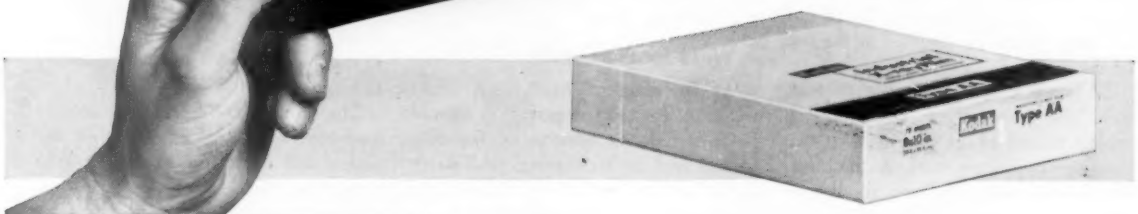

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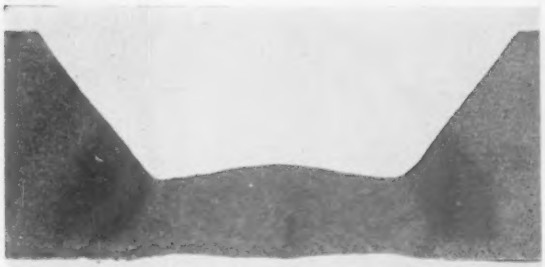


CRACK in pipe weld made by Tig welding process which does not penetrate to visible surface of root pass.

UPWARD progression of tungsten torch directed perpendicularly toward the center of the pipe.

On some of the more difficult-to-weld alloy steels which are considered highly susceptible to centerline and crater cracking, the flat-land bevel preparation would definitely be preferred.

Insert Rings

In horizontal rolled and vertical position welding, insert rings should be inserted into the beveled pipe concentrically. In horizontal fixed position welding, insert rings should be inserted eccentrically to the centerline of the pipe

Where insert rings with positioner pins are used for fixed position welding of flat-land and U-bevel preparations, the part of the ring containing the positioner pin closest to the OD of the ring should be inserted at the top of the pipe.

It is sometimes desirable to tack weld the insert ring (with a Tig torch) to one of the pipe ends at two locations before assembly of the joint. For best results, the arc should be struck on a small copper plate and touched to the ring.

On stainless steels, argon is generally used for both shielding and purging. On carbon and chromium-molybdenum alloy steel, helium is sometimes preferred for shielding.

Pencil-Point Tip

Thoriated tungsten electrodes, 1/16-in. or 3/32-in. in diameter, are generally used with a ground pencil-point tip. The tip should project about 3/16 in. below the torch cup.

All welding should be done with direct current, straight polarity (*i.e.*, the electrode should be on the *negative* side of the line).

Although tack welding may not be necessary where piping is securely fixtured by means of external line-up clamps, it is usually desirable. On piping up to, and including, 4-in. nominal diameter, two 1/8 to 1/4-in.-long tack welds should be made on opposite sides of the pipe joint.

On larger-diameter piping four or more tack welds should be made at equal distances from each other, with maximum distance between tack welds of about 6 in.

Tack welds should not be fused through the full land thickness. Before breaking the arc, the tungsten electrode should be manipulated slowly toward, and up the side of, the bevel. This helps avoid weld craters and crater cracks.

The tungsten torch should be held perpendicular to the joint area and be directed toward the center of the pipe. The arc length should be approximately 1/8 in.

Welding Procedure

At the start of welding, a slight weaving, forward progression should be followed. As base metal becomes heated and the weld metal pool more fluid, forward motion should become straighter and more uniform.

When finishing a root pass, an experienced weldor may prefer to feather out the arc gradually over a distance of 1 in. over the previously completed root-weld instead of breaking it on the side of the bevel.

In welding in the horizontal fixed position, the weld should be started at the bottom of the pipe and proceed toward the top, completing first one half, then the other half of the pipe joint.

Offsets and Gaps

Under average welding conditions an offset of about 3/32 in. and a gap of 1/16 in. can be readily welded. In fact, with expert weldors greater offsets and wider gaps can be bridged without resulting in defective welds.

When properly made, the underside of root-pass welds will appear smooth and uniform. There will be little or no weld projection into the inside of the pipe.

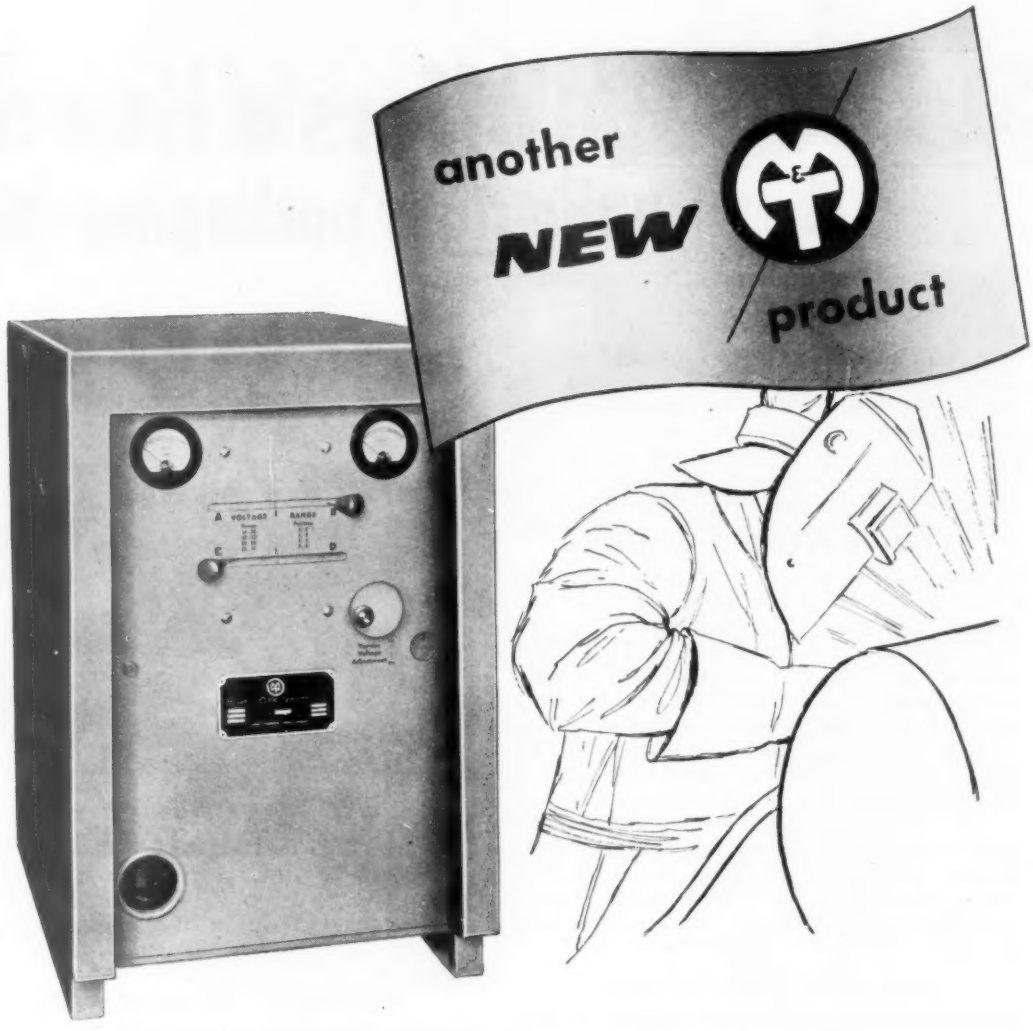
After completion and inspection of the root pass, the balance of the weld is usually made by shielded metal-arc welding with coated electrodes. Other welding processes, such as automatic submerged-arc welding and Mig (metal inert-gas) welding, are also occasionally used.

On stainless steels (and frequently on alloy steels), it is desirable to protect the underside of the weld from oxidation and discoloration. This protection is given by displacing air under the joint area with inert gas.

Argon is generally preferred on stainless steels and helium on carbon and chromium-molybdenum alloy steels. On austenitic stainless steels nitrogen has been found satisfactory as a purging gas.

The root-pass should be carefully inspected by visual examination for crater and centerline cracking. This inspection should be done in the as-welded condition. Grinding, chipping or wire brushing should be done only after inspection has been completed.

". . . Gimme a new cutting tip. This one's dull."



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SIMPLIFIES OPERATION — for all practical purposes it maintains a constant arc length during entire welding cycle, thereby assuring a uniform deposit.

IMPROVES WELDING — uniform deposits are of high quality, regardless of conditions which normally affect arc length such as poor fit-up, tack welds, etc. — avoids undercutting on horizontal welds.

SPEEDS PRODUCTION — instantaneous starting and recovery get job underway faster with higher average rate of deposit — practically eliminates rejects.

CUTS POWER AND INSTALLATION COSTS — high efficiency and power factor permit lower wiring and operating power costs.

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PAGE offers a line of —the right packaging—the

In ever-increasing numbers, users of welding wire are looking to PAGE for their wire needs. The one biggest reason is that they have found that PAGE—in a unique degree—has the *facilities, experience* and *special skills* to draw and furnish exactly the right wire for your welding jobs. And behind that lies a story.

All Processes Closely Controlled

PAGE is *the one supplier* of welding wire who is in a perfect position to control the chemical and physical properties of its products all the way from billet to rod to finished wire. That is because we purchase our raw materials to rigid specifications; we select heats of carbon, low alloy and stainless steels for certain optimum characteristics—then, upon delivery to the mill, we analyze representative samples for compliance with PAGE specifications.

These purchasing and testing practices permit the production of wire capable of depositing weld metal which complies absolutely with welding requirements. *You don't have to compromise* when you buy, specify or use welding wire by PAGE!

Page Meets Today's Needs

One example of PAGE's facilities for furnishing a wide range of quality-controlled welding wires for modern applications is shown by our stainless steel automatic welding wire. To meet needs of recent developments in the field of inert gas welding, PAGE offers fine wires (.020″ to .09375″) for use in semi-automatic arc welding machines in which the arc is shielded with argon, helium or CO_2 inert gas. These wires, wound on non-returnable plywood reels, furnish the utmost in convenience and freedom of wire feed.

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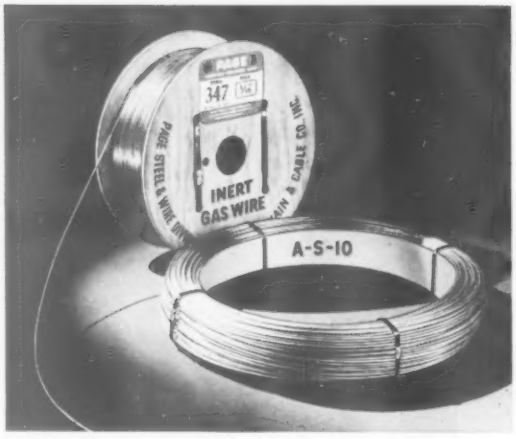
You will find many advantages in standardizing on PAGE welding wire for your needs—whether for automatic or manual use . . . arc or gas welding of all types. Not only does PAGE offer a wide range of analyses, as shown in the column at the right, but we have unsurpassed facilities for manufacturing wire to any desired size, temper or surface finish—and can furnish it promptly, in many methods of packaging, through the convenient nation-wide PAGE Distributor service.



The Right Wire— Wide Analysis Range

There are *26 different analyses* in the PAGE line. These cover the field of applications: heavy automatic submerged arc...light manual submerged . . . inert gas manual . . . automatic, tungsten or metal arc.

AUTOMATIC WELDING WIRE

CARBON STEEL...Any carbon from Armco (.025 max.) to high carbon (.90-1.10)

LOW ALLOYS...All the most popular welding grades.

STAINLESS...All standard AISI grades. Other types on request.

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Since 1914, the standard of quality, uniformity and satisfactory performance. PAGE offers an exceptionally wide range of rods—furnished in 36-inch lengths, in coils or on reels in the following materials: Mild Steel • Armco • Low Alloy • Carbon Steel • Stainless Steel • Manganese Bronze • Naval Bronze

BARE ELECTRODES

PAGE Bare Electrodes are supplied in any carbon from Armco to high (.90-1.10) carbon.

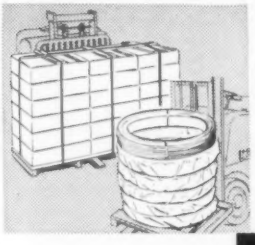
METAL SPRAY WIRE

Furnished as follows: Any carbon from Armco to 1.00 carbon • Low Alloy • Stainless Steel • Manganese Bronze • Naval Bronze

the right welding wires
right service—for modern needs

PAGE WIRES ARE PACKAGED RIGHT

PAGE Welding Wires are packaged in a wide variety of ways for the most complete protection and the utmost convenience in handling, in stocking and in use.

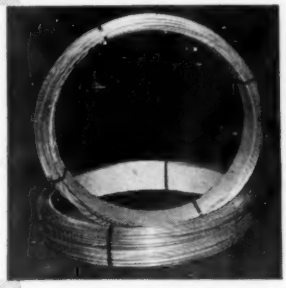


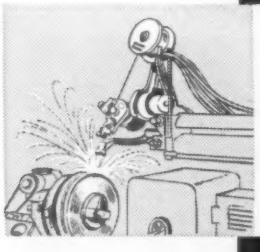
Wrapped Coils and Coils in Cartons

Single and palletized coils, each coil steel-strapped and wrapped in waterproofed paper. ...Also, coils in individual cartons, singly or palletized.

Welding Wire in Coils

PAGE A-S Automatic Welding Wire is regularly furnished in layer wound coils with cardboard liner, four Signode straps to facilitate coiling and easy unwinding.



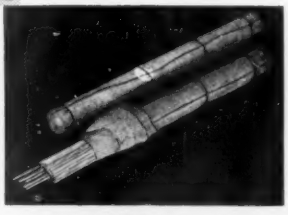


Handy Reels

PAGE Inert Gas Welding Wire is available on reels: Precision thread-wound on twenty-five-pound, non-returnable reels to fit all popular inert gas welding machines.

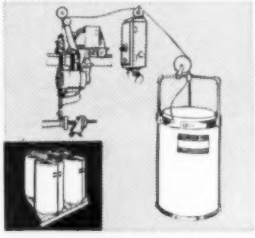
Gas Rod Packing

Gas welding rods are packed in 36" lengths in 50-lb. bundles—paper and burlap wrapped. Also in coils and reels (approx. 150 lbs.)—burlap wrapped. Stainless rods also come in 10-lb. fibreboard cartons.



LEFT: Pay-off-pak ready for filling, with "wire slinger" for uncoiling at extreme left. RIGHT: "Wire slinger" installed for feeding out wire; also, below, re-usable lid and retaining ring. Ring insures smooth feed-out of wire without snarls or kinks.

Sketch at right shows Pay-off-pak for continuous feeding up to 500 lbs. of wire without rethreading. Also (inset) lightweight Leverpaks. Both these containers protect against coil distortion... are easily opened, resealed, handled, stored.



PAGE Service Means Prompt Delivery From Local Stocks

You can get PAGE automatic arc welding wire, or oxy-acetylene welding rods quickly and easily from your nearby PAGE Distributor.

PAGE Distributors carry ample stocks from which your requirements can be filled without delay or inconvenience to you. This handy service not only saves you time in getting what you need, but makes it unnecessary for you to make a sizeable investment in inventory.

Send For These

Folder **DH-402A**—PAGE Submerged Arc and Inert Gas Welding Wire.

Booklet **DH-1277**—PAGE Gas Welding Rods.

Write our Monessen, Pa., office for *either or both*

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Better Value

IMPROVISED braces literally keep weldor for Northern Illinois Gas Co. afloat in deep pool of mud while joining sections of 8-in. gas main. Pipe welding played important part in state road improvement plan. This weldor is rerouting pipe around a new culvert; section of old main can be seen at lower right.

On the job...

ISOTOPES are put to valuable use inspecting longitudinal seam weld (white line, right) in 4-in.-thick steel shell. Special film outside cylinder records radiations from cobalt source in antenna. Machine in background carries cobalt; unit was manufactured by G. A. Harvey & Co., Ltd., London, England.

SPECIAL Tig welding torch was designed by engineers of Griscom-Russell Co., Massillon, Ohio, to automatically weld thin-wall tubes. Above, small weld bead is laid around base of heat exchanger tubes as they are joined to tube sheet. Process has been applied to similar units for nuclear marine power plants.

—Metallizing Engineering Co., Inc.

HARDFACING unit gives 0.010 to 0.040-in. metal build-up to automobile crankshafts ground below production standards at American Motors Corp., Kenosha, Wis. Shafts formerly were scrapped at a loss of over $14. Operators now spray 50 crankshafts per day, have reportedly saved firm over $600,000 since 1950.

In **ALUMINUM** too

here's how to get more for your money!

Call your nearby Tube Turns' Distributor. He can fill *all* your needs in welding fittings and flanges—aluminum as well as other piping materials. He provides industry's most complete line—over 4,000 top quality items—different sizes, types, schedules, materials; hence, this one source saves you purchasing time, cuts red tape. He acts as your warehouse. He gives you prompt delivery. And through him, Tube Turns' Engineering Service gives you valuable application help. To take advantage of this cost-cutting service, specify and buy TUBE-TURN Welding Fittings and Flanges.

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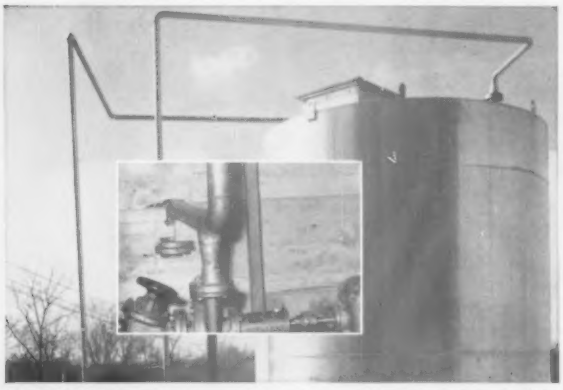
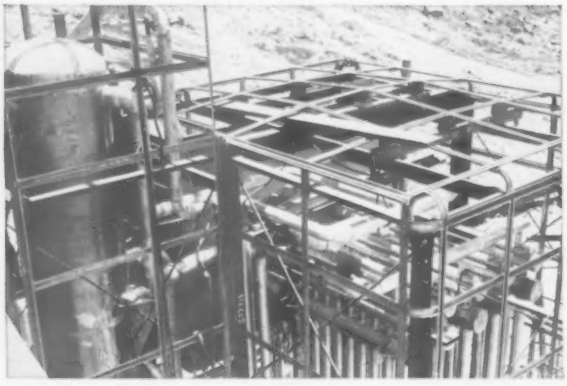
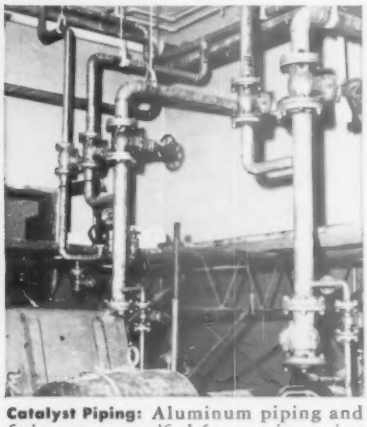
helps you apply aluminum piping on jobs like these...



Oleic Acid Storage: Here, 2" aluminum lines carry oleic acid in this installation for a rubber company. TUBE-TURN Aluminum Welding Fittings are used for directional changes. Insert shows a compact combination of these fittings at a pump . . . an elbow, tee, reducer and flange.

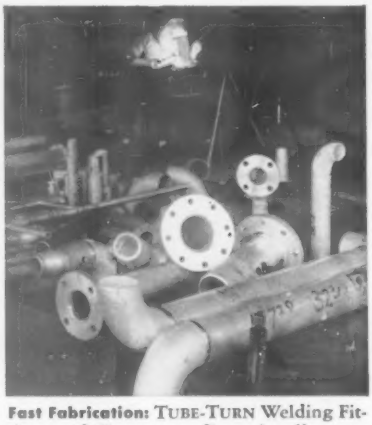


Oxygen Plant: TUBE-TURN Welding Fittings were used throughout this 25 tons-per-day oxygen plant for ore recovery. Here, operating temperatures range from 100°F to −320°F. Picture above shows reversing heat exchangers and fractionating tower prior to being enclosed in insulating shell.



Catalyst Piping: Aluminum piping and fittings were specified for certain services in this new TCR bead catalyst plant to prevent contamination of the catalyst. TUBE-TURN Welding Fittings and Flanges were employed in all aluminum lines from 1" to 10". Result: Lines are permanently leak-proof—maintenance is minimized.

Refinery Wax Coils: Originally, retubing of seven wax sweaters in a large refinery called for coils of another metal. Switch to aluminum piping and TUBE-TURN Welding Fittings saved $50,000 in material costs! Each unit required 900 TUBE-TURN 180° Welding Returns of 1" OD.



Fast Fabrication: TUBE-TURN Welding Fittings and Flanges are dimensionally accurate. Rigid inspection by Tube Turns assures true circularity and uniform wall thickness. Result: Alignment is perfect; fabrication is faster; installation simplified.

NEW BOOKLET—This new Tube Turns' catalog gives helpful information on aluminum pipe, fitting and flange materials. Mail the coupon for your free copy.

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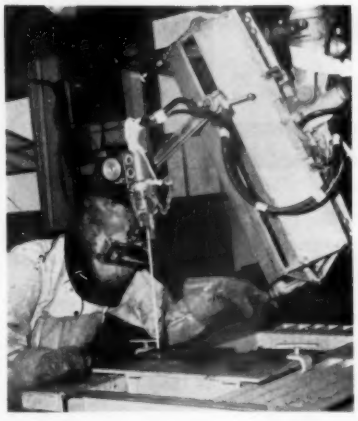
As superintendent retires . . .

Navy welding lab hails 25 years of growth



SEMI-automatic welding machine (at left) for testing electrodes was developed by retiring superintendent Ronay (above) and staff of the Welding Lab.

WITH Bela M. Ronay at the helm, the Welding Laboratory of the U.S. Naval Engineering Experiment Station, Annapolis, Md., has grown from infancy to maturity in the development of welding techniques and procedures.

With Mr. Ronay's recent retirement as superintendent of the laboratory, its many development programs were recalled. Mr. Ronay was appointed to organize the Welding Laboratory shortly after joining the station as senior welding engineer in 1931.

The Navy needed information on welding materials, equipment and procedures for the fabrication of highly stressed components of shipboard machinery.

Initial Problems

The first problems confronting the infant laboratory were how to determine suitability and predict performance of welding materials. An investigation of welding electrodes was begun.

Investigation results were published in a report which defined factors governing electrode performance: mechanism of metal transfer through the arc; the relationship between composition and structure of core wire and melting rate; coating properties, and arc stability.

The second major job undertaken by Mr. Ronay and his colleagues was the development of methods for welding high-temperature, high-pressure steam piping.

Welding Laboratory research led to the development of low-frequency induction heating equipment, methods for stress-relieving joints, and apparatus for fatigue testing. These innovations made sound welded fabrications for high-temperature, high-pressure steam service possible.

Scope Increases

Over the years, the scope of work in this field has increased to encompass various problems connected with the use of steam generating equipment. The lab recently designed and constructed five intricate installations for the ASME investigation of tubing materials for steam temperatures between 1,100-1,500 F.

A big problem during the mobilization period in 1941 was stress corrosion of brass weldments. The laboratory solved it by working out methods for the quantitative determination of residual stress, and methods for determining postheat treatment required for relaxation of residual stress.

The development of the arc air method of cutting steel under water was a wartime achievement of the laboratory. Battle-damaged ships were sinking and cluttering vital harbor areas.

The Welding Lab went to work to develop a fast means for cutting up unsalvageable hulls, and devised arc air cutting electrodes and related equipment to do the job.

During the same period, underwater welding techniques were devised to repair ships so they could fight again.

Propeller Shafts

Another wartime achievement was the development of a procedure for repairing battle-damaged propeller shafts. In collaboration with welding electrode producers, Mr. Ronay and his staff worked out a procedure for full-scale repairs.

Also during the war years, a simple method had to be found for inspecting hard-to-reach welded interiors of crankcases in the huge, complex diesel engines used in submarines and some surface vessels.

The Lab's development of a quick and effective oil powder method of flaw detection provided the solution to this problem.

Another undertaking of the Welding Laboratory was the development of a method for prolonging the life of cast steel propellers. Mr. Ronay developed a hardfacing process (see WELDING ENGINEER, April, 1956) for the accomplishment of this end.

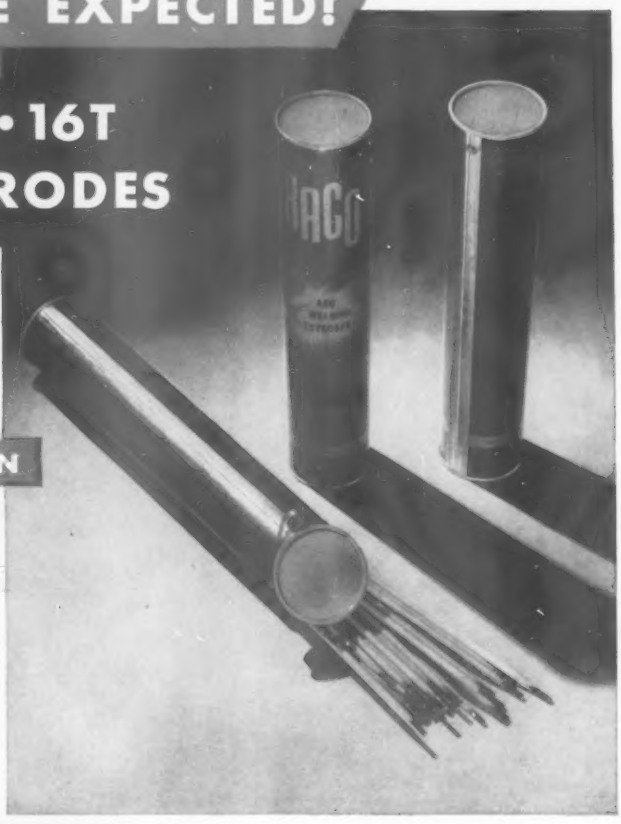
Mr. Ronay, who recently received a Meritorious Certificate from the American Welding Society for his work, started out in the Welding Laboratory with only one helper. In the middle thirties, five others joined the staff.

From its humble beginnings, the Welding Laboratory has expanded until it now has equipment to make test weldments by practically all methods known to science.

BETTER THAN WE EXPECTED!

RACO

120 • 16T ELECTRODES



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Welding T-1 Steel Plate

HIGH TENSILE

EXCELLENT ELONGATION

HIGH IMPACT

HEAT TREATABLE

Field reports have proven beyond a doubt that the new RACO 120-16T electrode for welding "T-1" steel is unsurpassed in quality. But there's only one way to find out—see for yourself. Order 120-16T's from your distributor or direct, or write for detailed description.

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RACO "PAY-OFF-PAK"

Large industries have proven the tremendous savings realized through the use of this unique method of dispensing wire for all types of automatic welding. 500 lbs. of wire in one coil eliminates necessity of constantly changing and reloading of smaller coils. Wire stays free from kinks, bends, twists and crossed strands for positive wire feed at increased welding speeds.

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SINCE 1919 PRODUCERS OF ARC-WELDING ELECTRODES AND WELDING RODS

Selecting copper and copper-base alloys—Part II

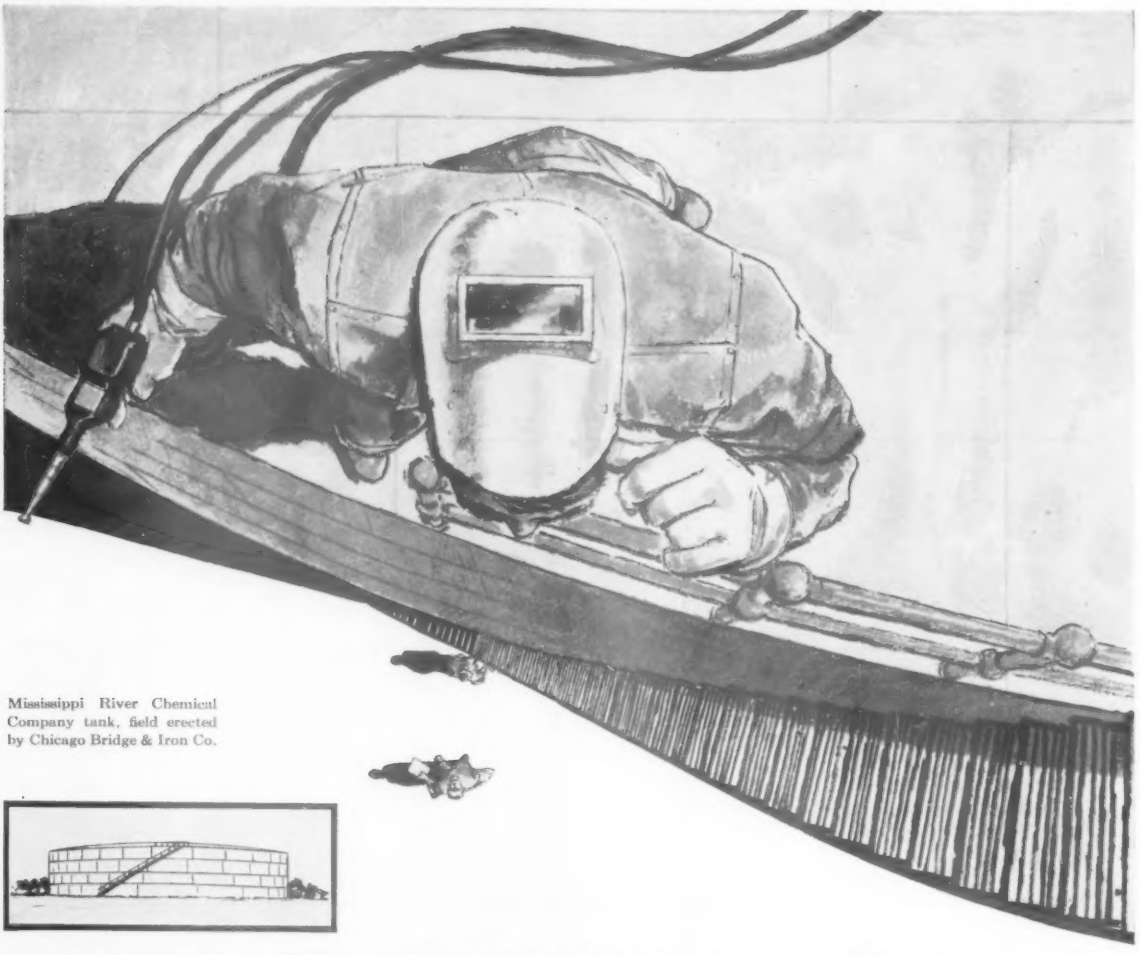
(See Part I—**Classifying copper and its alloys**—in the July WELDING ENGINEER, p. 69)

Standard Commercial Wrought Copper and Copper-base Alloys	*Electrical Conductivity* 1	*Electrical Resistivity* 2	*Thermal Conductivity* 3	*Coefficient of Thermal Expansion* 4	*Modulus of Elasticity* 5
ELECTROLYTIC TOUGH PITCH COPPER	101	10.3	226	98	17
DEOXIDIZED COPPER	85	12.2	196	98	17
OXYGEN-FREE COPPER	101	10.3	226	98	17
GILDING, 95%	56	18.5	135	100	17
COMMERCIAL BRONZE, 90%	44	23.5	109	102	17
RED BRASS, 85%	37	28	92	104	17
JEWELRY BRONZE, 87.5%	40	26	100	103	17
LOW BRASS, 80%	32	32	81	106	16
CARTRIDGE BRASS, 70%	28	37	70	111	16
YELLOW BRASS	27	38	67	113	15
MUNTZ METAL	28	37	71	116	15
LEADED COMMERCIAL BRONZE	42	25	104	102	17
LOW-LEADED BRASS (TUBE)	26	40	67	112	15
LOW-LEADED BRASS	26	40	67	113	15
MEDIUM-LEADED BRASS	26	40	67	113	15
HIGH-LEADED BRASS (TUBE)	26	40	67	113	15
HIGH-LEADED BRASS	26	40	67	113	15
EXTRA-HIGH-LEADED BRASS	26	40	67	114	14
FREE-CUTTING BRASS	26	40	67	114	14
LEADED MUNTZ METAL	28	38	71	116	15
FREE-CUTTING MUNTZ METAL	27	38	69	116	15
FORGING BRASS	27	38	69	115	15
ARCHITECTURAL BRONZE	28	37	71	116	14
INHIBITED ADMIRALTY	25	42	64	112	16
NAVAL BRASS	26	40	67	118	15
LEADED NAVAL BRASS	26	40	67	118	15
MANGANESE BRONZE, (A)	24	43	61	118	15
ALUMINUM BRASS	23	45	58	103	16
PHOSPHOR BRONZE, 5% (A)	18	58	47	99	16
PHOSPHOR BRONZE, 8% (C)	13	80	36	101	16
PHOSPHOR BRONZE, 10% (D)	11	94	29	102	16
PHOSPHOR BRONZE, 1.25% (E)	48	22	120	99	17
FREE-CUTTING PHOSPHOR BRONZE	19	55	50	96	15
CUPRO-NICKEL, 30%	4.6	225	17	90	22
CUPRO-NICKEL, 10%	9.1	90	22	95	18
NICKEL SILVER, 65-18	6.0	170	19	90	18
NICKEL SILVER, 55-18	5.5	190	17	93	18
NICKEL SILVER, 65-15	7.0	150	21	90	18
NICKEL SILVER, 65-12	8.0	130	23	90	18
NICKEL SILVER, 65-10	9.0	115	26	91	17.5
HIGH-SILICON BRONZE, (A)	7.0	150	21	100	15
LOW-SILICON BRONZE, (B)	12	86	33	99	17

NOTES:

1. % IACS @ 68 F (annealed)
2. Ohms per mil-ft @ 68 F (annealed)
3. Btu per sq ft per ft per hr per deg F @ 68 F
4. $\times 10^{-7}$, per deg F from 68 to 572 F
5. $\times 10^{6}$, psi

—Courtesy Copper & Brass Research Ass'n.



Mississippi River Chemical Company tank, field erected by Chicago Bridge & Iron Co.

World's Biggest All-Aluminum Tank Welded 100% With Alcoa® Alloys

This huge tank holds 2½ million gallons of highly corrosive ammonium nitrate. It's the world's largest aluminum tank—26 feet high and 128 feet across.

To handle the corrosive nitrate, the builder chose aluminum. For the highly stressed parts, Alcoa recommended Alloy 5052 which has a good combination of strength, corrosion resistance and weldability. We also recommended 5052 for the filler metal, a standard welding alloy, desirable here because of its corrosion resistance.

The big job was field erected, using the inert-gas, metal arc-welding process. The bottom course plates are 1⅛ inches and upper courses are progressively thinner, with a ⅜-inch-thick top course. Welds on the finished job were subjected to a standard dye check test. The tank passed this and subsequent water pressure tests with flying colors.

Alcoa made all the aluminum used on this impressive project but we're more proud of the service we were able to render—advising on the alloys, helping get the job started, being Johnny-on-the-spot when any problems came up. We would like to help you weld . . . braze . . . solder in aluminum. Call your Alcoa distributor listed at right. ALUMINUM COMPANY OF AMERICA, 1740-H Alcoa Building, Pittsburgh, Pa.

Your Guide to the Best in Aluminum Value

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

FOR IMMEDIATE DELIVERY, call one of the Alcoa distributors listed below. He carries a complete range of alloys and sizes of Alcoa Etched Finished Welding and Brazing Rod, I. G. Consumable Electrode, Brazing Metal, Solder and Flux.

For technical assistance, contact the nearest Alcoa sales office, listed under "Aluminum" in the yellow pages of your phone book.

ALABAMA
Birmingham
Hinkle Supply Co.

CALIFORNIA
Los Angeles
Pacific Metals Company, Ltd.
San Francisco
Pacific Metals Company, Ltd.

COLORADO
Denver
Metal Goods Corp.

CONNECTICUT
Milford
Edgcomb Steel of New England, Inc.

FLORIDA
Jacksonville
Florida Metals, Inc.
Miami
Florida Metals, Inc.
Tampa
Florida Metals, Inc.

GEORGIA
Atlanta
J. M. Tull Metal & Supply Co., Inc.
Southern Oxygen Co.

IDAHO
Boise
Pacific Metal Co.

ILLINOIS
Chicago
Machinery & Welder Corp.
Moline
Machinery & Welder Corp.

KENTUCKY
Louisville
Williams & Co., Inc.

LOUISIANA
New Orleans
Metal Goods Corp.

MARYLAND
Baltimore
Southern Oxygen Co.
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MASSACHUSETTS
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MISSOURI
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NEW JERSEY
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Southern Oxygen Co.
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Eastern Metals Warehouse, Inc.
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Columbus
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Tulsa
Metal Goods Corp.

OREGON
Portland
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PENNSYLVANIA
Philadelphia
Southern Oxygen Co.
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Pittsburgh
Williams & Co., Inc.
York
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TEXAS
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Seattle
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WASHINGTON, D. C.
Southern Oxygen Co.

WISCONSIN
Milwaukee
Machinery & Welder Corp.

Foot-operated spot welders changed to air rocker action

CONVERTING foot-operated spot welders to air rocker action is reportedly being done at a cost far less than that of a new spot welder with an air rocker arm unit.

Such conversions have been made at the Milwaukee (Wis.) Repair Dept. of Machinery & Welder Corp., Chicago. Cost of the machine conversion is said to be approximately only 25% of the purchase price of a new and fully-equipped unit.

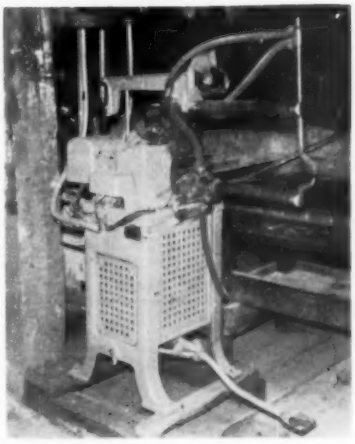
A foot-operated spot welder has a mechanical contactor which closes when the operator steps on the pedal. Weld pressure and weld time depend on foot pressure and on the length of time the operator's foot remains on the pedal.

In other words, all welds are subject to inconsistencies and quality cannot be controlled. Some are burned while others do not receive enough weld.

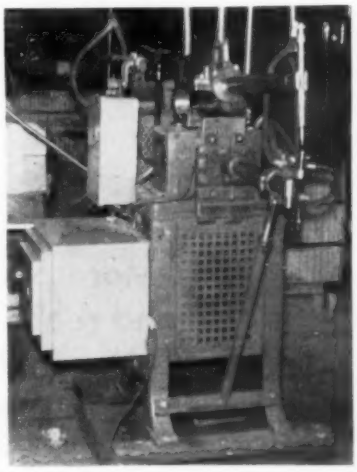
Some features which the service shop has put on machines after rebuilding include: air cleaners; air regulators; automatic air lubricators; lower arm braces, and automatic contactors.

Other features of rebuilt welders are: electronic weld timers which give a full sequence of squeeze, weld, hold and off time, and switches for single or repeat operation.

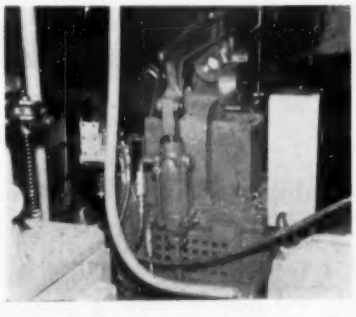
Air cylinders give rapid action of rocker arm plus consistent preset pressures (which can be preset by air regulators); pressure switches act as initiating switches and can be set for minimum pressure firing. Adjustable stroke features are also installed on the machines.



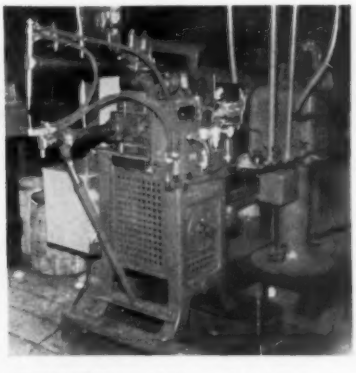
FOOT-operated spot welder before rebuilding. Machine has no timer.



FRONT view of machine after rebuilding shows lower arm brace.



REAR of rebuilt machine showing air cylinder attached to rocker arm.



REBUILT welder showing air cleaner, air regulator and air oiler.

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More people are reading and reacting to editorial and advertising appearing in Welding Engineer.

In 1955: 51,273

In 1954 . . . 14,321 Sales Leads

Since the younger management has taken over, *Welding Engineer* has run . . . 13% more pictures . . . 19% more articles . . . 9% more column inches of feature editorial material and produced nearly 400% more sales leads.

high-quality sales response

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Welding → Engineer

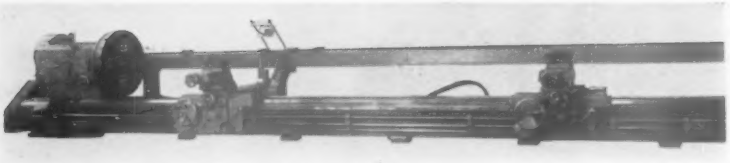
Sales Leads

In 1956*...

60,000 SALES LEADS

*Estimated on the basis of 13,340 sales leads in the first two months of 1956.

An analysis of sales lead respondents shows that 31% of the subscribers requesting more information were owners and executives . . . 30% had the title welding engineers . . . 12% were supervisory personnel—an amazing 73% had a title of foreman or better.



36-FT template carrier rail of welded steel is in position on a 50-in., two-directional duplicating lathe.

Welded steel replaces iron in lathe design

By George J. Kasselmann*

A TWO-DIRECTIONAL duplicating lathe with a 50-in. swing, made recently by R. K. LeBlond Machine Tool Co. of Cincinnati, Ohio, for turning steel mill rolls, was designed with a 36-ft welded steel template carrier rail.

The original design had been in cast iron, but manufacturing problems led to consideration of a welded steel design.

The 36-ft-long steel template carrier is supported only at its extreme ends to allow free carriage travel of lathe center capacity. Since any template inaccuracy would be doubled on the workpiece diameter, close tolerances are required throughout the unsupported length of the carrier rail.

Self-Supporting

The rail is straight within .003 in.; it resists side deflection within .0015 in. variation; it supports itself without transferring weight to the lathe carriage through the side alignment carriage bracket.

The rail was made of 5/8-in. plate formed into a U-shaped channel 36 ft long, 12 in. deep and 11¼ in. wide at the bottom. Stiffeners of ¼-in. plate, with 4-in. holes punched in them, were welded inside the channel at 45-deg angles to provide cross-bracing.

Welded on each side of the bottom of the rail for its entire length were 1¼ in. by 2 in. steel strips. Plates of 5/8-in. stock were fitted and welded in each end of the channel section. A rough, machined dovetail, 5 in. wide and 1¼ in. thick, was plug welded on top of the channel through punched holes.

Dovetails and strips on the bottom were planed parallel with a high center equal to the estimated deflection of the rail so that, when suspended, it would assume a near-straight line at the bottom and dovetail.

Sequences Planned

In order to arrive at desired accuracy when finished (and considering the rail's slender cross section, 36-ft length, and the fact that a quantity of metal was to be removed in machining), manufacturing sequences were carefully planned.

Welding was done by Armor Metal Products, Cincinnati, Ohio. The company elected to form and weld the body of the beam from plates 9 ft. long. Two portions were then welded together, making two 18-ft-long sections, which were welded flat on a level table.

Inside the channel, stiffeners were welded for the full length of each section. They were welded intermittently to side plates with 3-in. to 4-in. welds at the top and bottom corners, and to each other with 5-in. welds.

The 1¼-in. by 2-in. strips were welded to side plates with continuous welds inside and outside. The two 18-ft sections were then annealed and transferred to shops and placed on a long planer table where the center weld was completed.

This weld was critical. The two 18-ft sections were welded with a 0.375-in. rise in the rail at this point to allow for estimated deflection. In addition to 100% welds in the side plates, the bottom strips were machined and offset to provide an overlap of 9 in., which also was welded.

Welds Cool Slowly

Welds were allowed to cool slowly using a hand torch to provide heat. After the weldment cooled, it was checked in the rough by placing blocks at each end. It was found, for practical purposes, to be straight.

Planing of this long, slender section to control straightness and deflection required extreme care on every turn of the piece so as not to twist or bow any section. One side clamp screw set too tightly could induce a misalignment of 0.010 in., 0.015 in. or more. The sequence was as follows:

1. The rail was placed bottom down on the planer table (rocking was eliminated by packing under corners) and clamped. The middle was high because of the crown welded into the beam. Low side of the middle point was clamped flat to table. The other side was packed with an amount equal to variation of clearance as shown when center hung free. Top dovetail was then rough-planed.

2. The rail was unclamped and turned over; each end went up about 0.180 in. These ends were clamped down flat to planer table and all bottom strips were rough-planed.

Planing Operation

3. The rail was turned over to the first side for finish planing of the top dovetail. Before packing and clamping, with middle hanging free, it was 0.040 in. high. This showed the beam

CENTER weld joining two 18-ft sections is visible in side plates. Bottom side is up.

This article is based on an award-winning paper in a recent machine tool design competition sponsored by The James F. Lincoln Arc Welding Foundation of Cleveland, Ohio. Mr. Kasselmann is design engineer of R. K. LeBlond Machine Tool Co., Cincinnati, Ohio.

LOOKING into bottom, stiffener plates are welded at 45 deg.

was carrying its own weight without sag. The middle was then clamped flat to planer table and finished.

4. The last planing operation was to turn bottom up, carefully align edge of dovetail with planer tool, and clamp flat to table. Before clamping, ends were high—about 0.140 in. After planing the bottom, the rail was set top side up on parallel blocks under each end, with middle hanging free. It indicated the high center at 0.029 in.

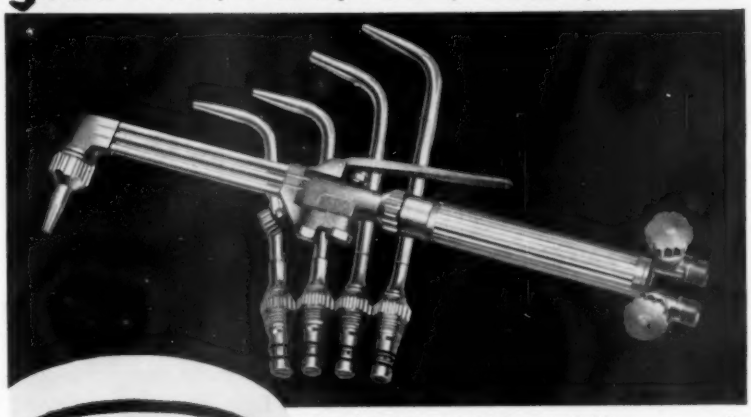
After cooling off, the center was 0.026 in. high. It maintained this shape until the completed machine was shipped about 45 days later.

In addition to its high degree of accuracy, this welded steel rail produced considerable savings in cost over an equivalent cast iron rail which would have weighed about 7,380 lb and cost approximately $1,623.60.

The steel rail was furnished as a fabricated weldment for $1,011.82. Finished weight of the weldment was 3,140 lb, as compared to the finished weight of the casting, 6,930 lb. This constituted a weight saving of 54.7%.

". . . I signed up for 20 more years!"

Light, handy Torch does multiple jobs... *cuts, welds, heats, brazes, solders*

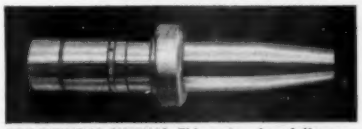


SMITH'S **"PIPELINER" Welding Torch and Cutting Assembly**

...with slip-in tips

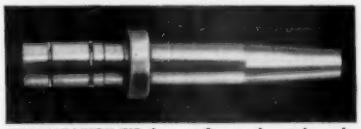
Developed originally for pipeline welders, this popular little guy has been drafted for all kinds of other uses. You can do welding from 1/32" to 1/4", and brazing and heating jobs. Eight other sizes of Soft-Flame tips increase welding capacity to 7/8". With the cutting assembly you can burn steel from 1/8" to 4" in thickness —clean, high speed cuts with minimum gas consumption. Insert special tips and you can do heavy scarfing, rivet washing and gouging. Tips slip in, tighten with finger twist (no wrench needed). Operators really like that handy 2 lb. weight! Over-all length 16". Your choice 90° or 75° head angle.

SPECIAL TIPS MULTIPLY THE JOBS YOU CAN DO

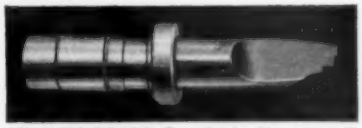


FOR GENERAL CUTTING. This series gives full range of work from 1/8" to 4". Ideal for pipe cutting and beveling, general production cutting, maintenance and repair jobs of all kinds.

GOUGING TIP. Used for gouging old welds and cracks in steel. Works equally well for deep gouges at minimum width or shallow grooves with considerable width.



"METALEATER" TIP for scarfing and metal washing, rivet washing and removal of stay bolts. Has heavy preheat and will remove a lot of metal fast.



FOR PLATE CUTTING. Two tips in this series will cut sheets and plates from 10 ga. to 1/2". Light preheat. Clean straight-line cuts with minimum gas consumption.

Full information on request — mail coupon

SMITH WELDING EQUIPMENT CORP.

DEPT. WE-192 • 2633 S.E. 4th Street • Minneapolis, Minn.

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ONE wide-range "OXWELD" W-45 BLOWPIPE handles EVERY welding and heating job

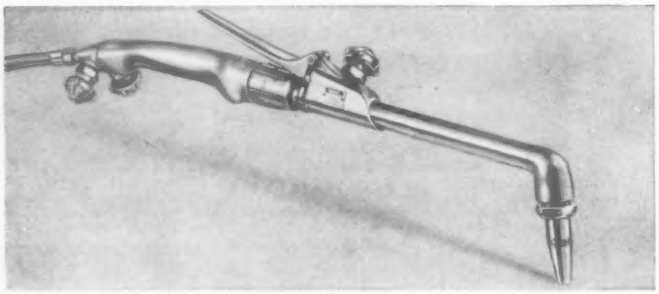
Trade-Mark

*NO OTHER SINGLE BLOWPIPE OFFERS THIS **EXTENSIVE RANGE!***

Anyone whose daily work includes welding and heating will readily appreciate the amazing wide range and versatility of the new OXWELD W-45 Blowpipe. Its 18 head sizes (2 to 300 cu. ft. per hr. capacity) provide a perfect flame for every metal thickness. Light sheet to heavy plate, *one blowpipe does it all!*

From chrome-plated tip to offset hose connections, the W-45 shows the results of over a decade of development work by LINDE engineers. Its exclusive "jiffy-lock" heads, "form-fit" handle, and advanced styling are as modern as guided missiles and atomic power. "O" ring gas seals, flame-stabilizing mixers of improved type, and many other innovations put this blowpipe far ahead of the field in economy, ease of operation, and low-cost maintenance.

See for yourself how you can enjoy tomorrow's operating standards today with an OXWELD W-45 Blowpipe. Ask your LINDE representative for a demonstration, or write for free booklet, F-8684.



CW-45 Cutting Attachment adapts the W-45 Blowpipe for cutting steel up to 8 inches thick.

Linde Air Products Company

A Division of Union Carbide and Carbon Corporation

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In Canada: LINDE AIR PRODUCTS COMPANY
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Linde Trade-Mark

The terms "Linde" and "Oxweld" are registered trade-marks of Union Carbide and Carbon Corporation.

Mr. Abel, Morris Rilling and Bob Sommerfeld with welder given as TV prize.

TV program acquaints public with welding

FOR THE past year, Miller Electric Mfg. Co., Inc., Appleton, Wis., has been sponsoring a half-hour TV show live from WFRV-TV, Green Bay.

The commercials are designed to acquaint the TV audience with the welding industry through simple explanations of various types of welders and the types of jobs for which they are best suited.

The show has presented demonstrations of how welders can be used on farms or in home workshops. The company says these demonstrations have been instrumental in educating the general public to the possibilities of welding.

Stars of the show are Dick Metko and his orchestra, a midwest recording group. The sponsors say the program has proved to be an entertaining half hour of fun and music.

In a recent contest, the firm gave away a combination welder and power plant. The award was presented on the program by Burnell Abel, vice president of Miller Electric, to Morris Rilling of Omro, Wis.

Mr. Rilling's essay on why he wanted to win this particular welder was chosen as the best of more than 400 entries received. Bob Sommerfeld of Oshkosh is the distributor from whom the winning entry blank was received.

**PHOS-TRODE*
— an improved phosphor-bronze electrode**

— for faster, better all-position welds on difficult metals

Ampco's Phos-Trode provides you with new advantages that permit faster, better all-position welds on difficult metals. You get finer-grained deposits with higher mechanical properties — without using special techniques.

This truly great phosphor-bronze electrode has an exceptional core-wire composition, and an improved coating. Spatter is reduced, amperages can be higher. You get faster deposition and greater efficiency. Beads are flat and smooth — with practically no undercutting, pitting, or porosity.

Take the difficulties out of difficult metals. Join cast iron, bronze, brass, copper, galvanized iron, and malleable iron, or any one of these to another.

Specify Phos-Trode for all your difficult welding jobs.

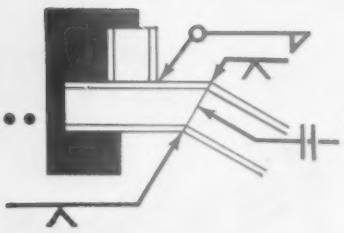
*Reg. U. S. Pat. Off.

AMPCO®

W-140

AMPCO METAL, INC.
DEPT. WE-8 • MILWAUKEE 46, WISCONSIN

THE METAL WITHOUT AN EQUAL



the welding clinic

Here you may find the solution to your welding problems, whether they concern design, production, construction or maintenance welding. Submit your questions for answering on this page.

Safe open-flame procedures

Question:

Oxyacetylene torches are used pretty extensively in our plant and there is, naturally, an ever-present danger of fire. We would like to establish some rules of safe conduct but, at the same time, we don't want to tie ourselves down with needless red tape. Can you give us some pointers on safety rules that other firms have used successfully?

Answer:

Because of fire hazards involved in the use of open flame and other spark-producing devices in certain plant areas, Eastman Kodak Co., Rochester, N. Y., has developed standard practices outlining specifically the conditions under which these devices can be used.

Open flames are regularly used in Kodak's metal shop, field department welding shops, certain chemical laboratories and other work areas. These areas are customarily referred to as *open flame areas* and are identified as such by a permit issued by the company's fire department and posted in a conspicuous location in the area.

Flexible Rules

In such areas, open flames can be used in accordance with requirements set forth on the permit without special permission. In all other areas, including buildings, sheds, yard areas and streets, open flames are strictly prohibited and cannot be used unless a permit has been issued.

Each permit issued is considered on its own merits, and may allow free use of open flame or may restrict their use to a single operation performed only by operating personnel of a specific area.

KODAK PARK WORKS

Open Flame Permit

For one or more of the following:

- ☐ Acetylene or Electric Burning
- ☐ Electric Welding
- ☐ Acetylene Welding
- ☐ Soldering with Torch
- ☐ Lead Burning

B 35068

Job Description:

Bldg. or Shed No. _____ Floor _____

Dept. _____

Date _____

APPROVED BY:

E. C. & M. Section Foreman _____

Dept. or Asst. Dept. Head _____

Fire Inspector _____

Operating Dept. _____

NOTE: NO WORK SHALL BE PERFORMED WITH SPRINKLERS SHUT OFF WITHOUT SPECIAL PERMISSION OF THE FIRE CHIEF.

THIS TAG MUST BE HUNG IN PLAIN SIGHT OF WORK AND MAILED TO FIRE DEPARTMENT WHEN WORK IS COMPLETED.

FACE of open flame permit tells nature and location of work, and carries signatures of approval. Back of permit contains check list of special precautions.

Where such restrictions apply, a temporary permit is required when the proposed use of an open flame does not conform with that set forth on the permit for the open flame area.

At Kodak, the fire department must regularly inspect all open-flame areas to see that changing conditions or processes do not create a potential fire hazard. In such a case, the department can revoke a permit. (*The work done by Eastman's fire department could be equally well done, in a small firm, by qualified inspectors.*)

Outside contractors, employing open flames at Kodak Park, must have permits secured for them by the department for whom they are working. Both department supervisors and contractors, then, assume responsibility for safe procedures.

Personal Inspection

Following up requests for open flame permits, authorized personnel must make a personal inspection of jobs in question and indicate approval on the permit.

Persons initiating permit requests meet fire inspectors at job sites to outline conditions under which work is to be performed. Advance notice of job starting times must be given to a fire inspector.

When a permit has been okayed, three copies of the form are distributed to personnel concerned. The fourth copy—a red one—is hung in plain sight of the work as it is in progress, then returned to the fire department when work is completed.

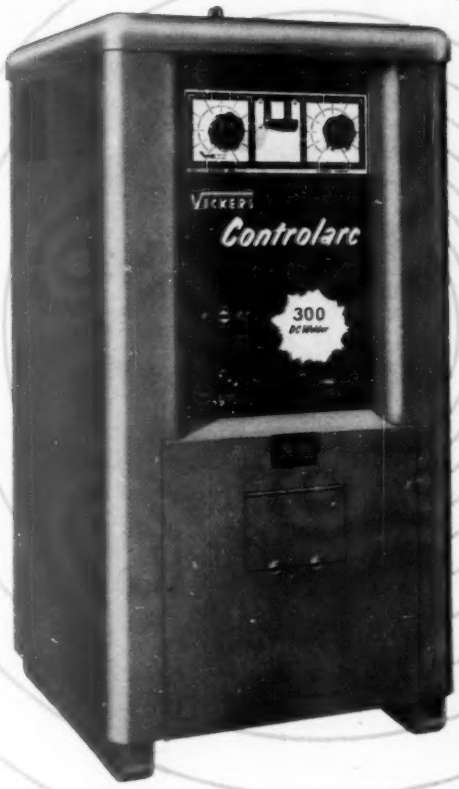
Fire hazards which may exist only in certain departments or in limited areas will also be included in the open-flame permit when work is done in these places.

Fire watchers frequently are required to be on hand during welding and flame-cutting field work at Eastman's plant. The fire watcher—uniformed and in full charge of fire protection—must carefully watch the travel of sparks and molten metal in areas where combustible materials are stored near the work site.

Where work is being performed on ducts, the fire watcher must see to it that sparks do not travel through a duct to an area where combustible materials are stored. He must also have a full fire extinguisher on hand during welding or flame-cutting operations.

for better welding on a wider range of jobs...

the Versatile VICKERS Controlarc DC Welder



IN EVERY DETAIL... ENGINEERED FOR SUPERIOR PERFORMANCE AND LONGER LIFE

- Maintains arc stability through the complete current range from extremely low to extremely high without range switches.
- Can bend the volt-ampere curve to meet the particular welding job being done.
- Gives full-range automatic arc control in any welding position.
- Can strike an arc without the use of high frequency when using inert gas and tungsten on extremely low current.
- Exclusive, patented Magnetic Amplifier combines fine control with ruggedness and durability.
- Exclusive, *dual* remote control equipment available ... provides close control of complete current and voltage range.
- Low spatter performance on special electrodes.

Plus Many Other Quality Features

Write today for illustrated brochure with complete information on the Vickers Controlarc DC Welder.

VICKERS ELECTRIC DIVISION

VICKERS INCORPORATED a unit of Sperry Rand Corporation

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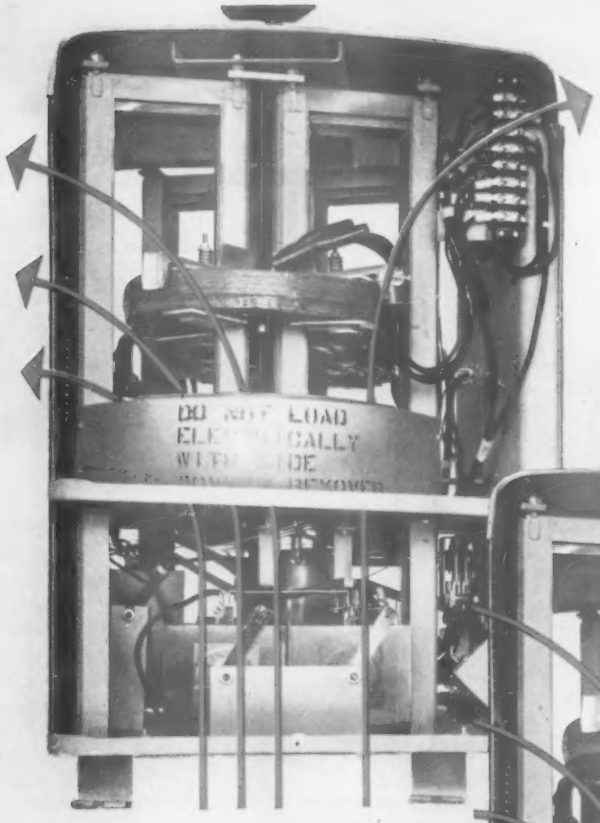
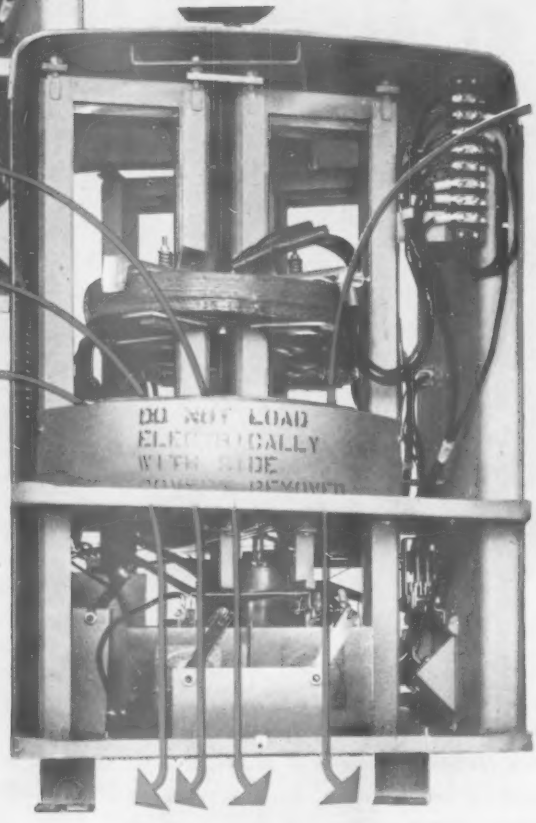


SWITCH
DOWN

With switch in normal down position fan draws cool air up through welder.



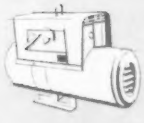
SWITCH
UP

With switch up air is blown down through rectifier stacks to dislodge dust.

FOR ALL YOUR WELDING NEEDS

General Electric offers all three types of heavy-duty welders—AC Transformer, DC Rectifier, Motor-generator—plus a complete line of equipment, accessories, and electrodes.

AC Transformer



Motor-generator

Engine Drive

General Electric Exclusive

Reversible Fan Dusts Off Rectifier in Seconds; Gives General Electric Rectifier Welders as Much as 50% Longer Life

Available only with General Electric rectifier welders, the 14-in. combination cleaning-cooling fan gives you as much as 50% longer welder life!

Here's why! This double-duty fan automatically cools the welder, continually drawing cool air from floor level, up through the rectifier stacks, and over the coils. The possibility of recirculating warm air is thus eliminated.

At the flick of the convenient switch the fan reverses, blowing accumulated dust off the rectifier stacks. This cleaning action helps free the stacks of fibrous dust which frequently blankets the leading edges of rectifier plates, blocking the air flow between the plates and causing burnouts.

Other exclusive features of this new line of General Electric rectifier welders include:

(1) FULL-TIME ARC-FORCE CONTROL which helps eliminate electrode sticking. This feature, exclusive with General Electric, permits the use of shorter arcs, because short-circuiting metal droplets which ordinarily would freeze to the electrode are blasted away.

(2) SILICONE INSULATION on both transformer coils helps protect the welder from damage due to overheating, fumes, and moisture.

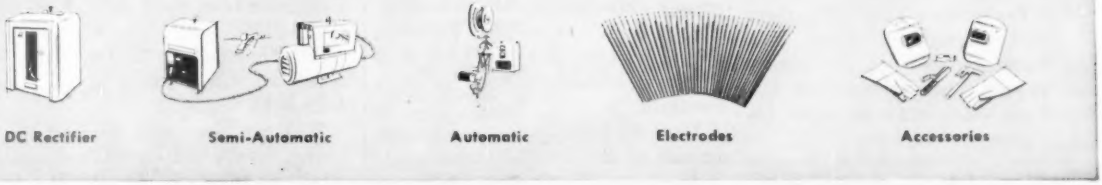
(3) EASILY REMOVABLE SIDE COVERS which come off with removal of just three screws. This simplifies routine maintenance; no need to remove primary leads or handles —no need to use cranes or hoists.

These and other G-E engineered extras (see comparison chart below) are available only with G-E rectifier welders. Contact your local General Electric Welding Distributor (he's listed in the yellow pages of your phone book) or write for bulletin GEA-6242, Section 711-5, General Electric Company, Schenectady 5, New York.

	Full-time arc-force control	Combination cleaning-cooling fan	Moving-coil design	Silicone Insulation	Aluminum-wound coils	Removable side covers	Reversing-polarity switch	Large, logarithmic current scale
General Electric	✓	✓	✓	✓	✓	✓	✓	✓
Manufacturer A					✓			
Manufacturer B							✓	
Manufacturer C			✓					✓

Progress Is Our Most Important Product

GENERAL ELECTRIC



DC Rectifier | Semi-Automatic | Automatic | Electrodes | Accessories

No. 7 in a series

Filler metals for joining

DRAMATIC example of heavy welding application for E6020-30 electrodes cited by author.

By Orville T. Barnett*

IN THE EARLY days of coated electrodes there were two types: gas-shielded and slag-shielded. Naturally, the gas-shielded, all-position electrode (today's E6010 type) represented a significant advance over bare-wire or lightly-coated electrodes.

Equally striking was the impact made by the heavily-coated, slag-shielded downhand and horizontal fillet electrode (today's types E6020-30). For positioned welding, the iron-oxide E6020-30 grades brought about a noteworthy increase in welding speed with weld metal quality that was to remain unexcelled for well over ten years.

As the covering specification appendix shows (*Tentative Specifications for Mild Steel Arc-Welding Electrodes*, AWS Designation A51-55T, ASTM Designation A233-55T), there is little difference between most E6020 and E6030 types. The former may be used for horizontal fillets and downhand welds, while the latter are restricted to downhand welding only. In this discussion, the two types will be treated together. Indeed, the NEMA statistical bulletins have grouped the two types together for years.

Heavy Welding Uses

These iron-oxide, all-mineral electrode types produced the high-speed, high-quality welds of the pressure vessel, railroad car, ship-building, machine base and other heavy welding industries.

Nowadays, automatic welding has replaced the E6020-30 electrode classes wherever long runs or fixturing leads to cost savings. However, downhand welds and horizontal fillets will still be made by hand in many instances.

Until the E6027 iron-powder counterpart of the E6020-30 types gains wider acceptance, the latter will continue to receive wide use. Some 30,000,000 lb a year of mild-steel electrodes are E6020 and E6030 types.

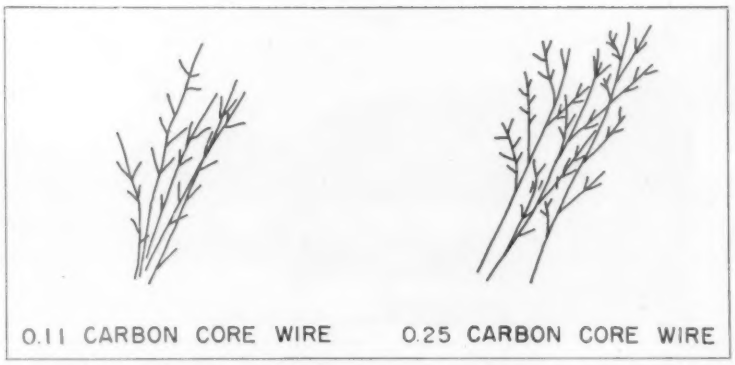
Popularly known among weldors and welding engineers alike as "hot rods," the iron-oxide electrodes were used in large diameters at currents that often were limited only by the size of the power source.

High-Current Usage

Normally specified for base metals of 3/8 in. or more in thickness, the iron-oxide electrodes work well with relatively high currents in the diameter range from 3/16 through 5/16 in. Diameters from 1/16 through 3/8 in. are available from electrode manufacturers, but almost 90% of the tonnage consumed still is found in the span from 3/16 through 5/16 in.

Why are very small diameter electrodes, usually considered sheet metal types, manufactured at all? The ex-

*Assistant Manager, Metals Research Dept., Armour Research Foundation of Illinois Institute of Technology, Chicago.



SPARKS typical of the two different types of core wire used in E6020-30 electrodes.

planation is found in millions of welding applications.

Sometimes an off-trail combination works best. In one case, a lug was welded to an electric motor frame with 3/32-in. E6020 electrodes; cost and appearance results were outstanding. Similarly, one of the largest fabricators of power piping has used 1/8-in. and 5/32-in. EXX20 electrodes, usually carbon-moly grades, for all-position welding for many years.

Hot rods have always worked well with a-c as well as d-c on either polarity. As previously explained, good a-c performance is a function of coating design. In the case of heavy mineral-coated electrodes used for deposition in deep grooves, this good a-c performance was a godsend.

Magnetic Blow Solved

Magnetic blow, of course, is a function of current. With high amperage and the unusual magnetic conditions prevailing at the ends of deep grooves or at corners where fillets come together in gusseted structures, even highly skilled weldors were driven to distraction by turbulent, almost uncontrollable, molten weld metal pools.

A-c brought peace and tranquillity to these trouble spots. For girth seams of pressure vessels, either a-c or d-c is satisfactory. When choosing d-c, straight polarity gives the fastest deposition rate.

The thick, refractory crucible around the end of an E6020-30 electrode during welding permits some production advantages. A horizontal fillet weld with slight penetration may be made by holding a definite arc and keeping the current low, perhaps about 280 amp for a 1/4-in. electrode.

Deep penetration can be obtained at 380 amp using a 1/4-in. electrode dragged in the corner and moved ahead at a rate sufficient to permit good digging action by the forceful arc.

Mechanical Properties

Fine mechanical properties are exhibited by the mineral-type E6020-30 electrodes. Yield strength and ultimate strength are good, but may flirt with lower limits of specified values when large-diameter electrodes are deposited at high amperage in multiple passes where the deposit is above 400 F between passes.

Ductility is very good, as demonstrated by elongation and reduction of area. Impact strengths are good, but Charpy vee-notch values below O F may not exceed 15 ft-lb at all times.

If low-temperature impact strength is of great importance, E6016 electrodes offer advantages. Soundness, reflected by density and X-ray inspection, is excellent. Until E6016 electrodes came on the scene, E6020-30 electrodes were unequalled for quality of weld deposits.

Deposit chemistry of E6020-30 electrodes is typical of mild steel weld deposits. Nor does chemistry vary much with the two different types of core wire used for these electrode types.

Check Core Wire

Some manufacturers favor a high-carbon (0.25%) core wire while others use a low-carbon (0.11%) core wire. To determine the core wire type in your hot rods, check them against an E6010 or E6012 core wire on a grinding wheel.

If the two sparks look alike, you have a low-carbon core. If the E6020-30 core wire throws sparks with more branches and bursts, this indicates a higher carbon core wire. This factor may be important if you are looking for different performances from your iron-oxide electrodes.

Heretofore, whenever a-c welding characteristics were emphasized, attention was drawn to the use of potassium ions in the coating to achieve this purpose. In this respect, E6020-30 electrodes represent a true anomaly: they are a high iron-oxide, sodium-type electrode.

Weld Concavity

In addition to substantial amounts of iron oxide, the coating contains manganese oxide, silica, asbestos and other ingredients including ferromanganese for deoxidation and sodium silicate for a binder. Senior welding engineers who have been in the business since the early 1940's remember the spiral winding of asbestos in the coating of one of the first hot rods manufactured in the United States.

Mineral-coated electrodes in this

TYPICAL MECHANICAL PROPERTIES OF E6020-30 ELECTRODE DEPOSITS—AS WELDED

Yield strength, psi	52,000-60,000
Ultimate strength, psi	62,000-73,000
Elongation, % in 2 in.	25-30
Reduction of area, %	35-60
Brinell hardness number	150-170
Impact strength, Izod ft-lb	30-60
Impact strength, Charpy keyhole, 70 F	20-30
Impact strength, Charpy keyhole, —40 F	15-20
Endurance limit, psi	28,000-34,000
Specific gravity, grams/cc	7.84-7.86
Corrosion resistance	Comparable to mild steel
X-ray quality	Excellent

"When welding cast iron, I call for the Airco 77 Electrode"

The deposit of the Airco 77 Electrode is of higher tensile strength than cast iron. It is excellent when machinability of the deposit is not required. The weld metal bonds well, and since it can be applied with comparatively low currents, the hard areas at the fusion zone are materially reduced in cross section. Some applications for the Airco 77 electrode are welding of cylinder blocks and heads, machine parts and large frames.

This is but one of many electrodes in Airco's complete line that also includes stainless steel, hard-facing, cast iron, general and special purpose electrodes. Send for free Airco Electrode Guide which will help you select the right electrode for your specific job. Request catalog 1318-WE.

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—*Courtesy Pusey & Jones Corp.*

ALL-welded steel dock was fabricated mainly with large-diameter E6020 electrodes. Welds were made in downhand position wherever possible.

classification produce horizontal fillet welds that are flat or slightly concave. Too much speed will increase concavity, sometimes to the point where insufficient throat thickness remains. Cracking may easily result.

Another potential cause of cracking is the *blue brittle* range of these weld deposits. Some critical stress conditions arise when one fillet weld is placed opposite another in some thickness ranges. A slight gap in fit-up, allowing stresses to be relieved through movements of the parts, is frequently helpful in such situations.

The arc is generally a spray type. In groove or fillet welding, the weldor controls his deposit by watching slag coverage. With practice, he becomes as skilled as any fingerprint expert at watching his bead.

Iron-oxide, manganese-oxide silica slag is quite voluminous and is honeycombed adjacent to the weld. When cold, the glass-like slag is easily broken away. Generally, wire brushing is sufficient between passes.

Reaction Pits

Attention has been called to dimpling of the surface of fillet welds or concave groove welds. This condition is more pronounced with a-c than with d-c. It is said to be influenced by atmospheric conditions.

In extreme cases, dimples appear as deep surface holes sometimes called *reaction pits*. Such pits are most often encountered in the narrow portions of deep grooves.

That they result from too much deoxidation is readily proved by welding over a slight amount of mill scale or iron ore in the bottom of such a groove. The pits will no longer form. It is not recommended that welding engineers become coating doctors who prescribe remedies such as this one. A somewhat longer arc should prove equally efficacious.

Hot rods worked miracles of speed and quality when compared with E6010 electrodes, against which they first competed. But high-speed welding has changed with the times. Iron-powder electrodes give speed and high current, too.

Which is Best?

Since speed must be measured in terms of feet of seam completed per unit of time, it takes patient time study analyses to ascertain which type of electrode to use.

Some applications will yield the best balance of quality and cost with E6020 electrodes. Other weldments may be fabricated with E6013 electrodes and offer highly desirable results. Still other fabricated assemblies are best built with E6024 electrodes.

As long as manual welding remains with us (and this promises to be a good long while), E6020-30 electrodes will occupy a prominent niche.

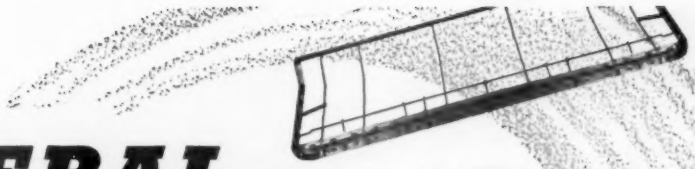
SUGGESTED CURRENT RANGES FOR E6020-30 ELECTRODES

Diam. (in.)	Amp	Volts
1/8	90-150	23-29
5/32	120-200	25-30
3/16	175-250	26-35
7/32	200-325	30-36
1/4	250-425	32-38
5/16	350-525	32-42
3/8	400-600	34-46

REFERENCES

Manufacturers catalogs.

Tentative Specifications for Mild Steel Arc Welding Electrodes, (AWS Designation A5.1-55T, ASTM Designation A233-55T).



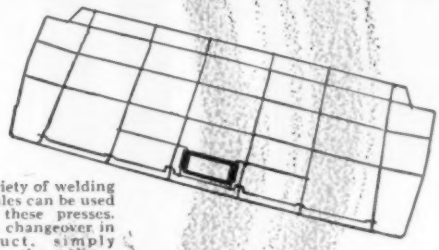
FEDERAL WELDING PRESS . . .

a complete seat frame with every press stroke!

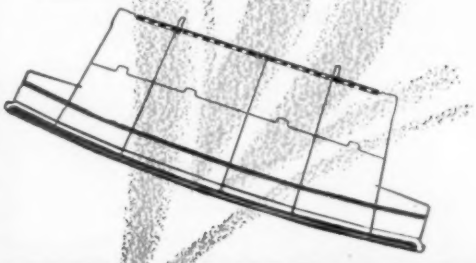
Frames for automobile seat backs and cushions are being resistance welded on Federal Welding Presses at the Great Lakes Spring Division of Rockwell Spring and Axle Co.

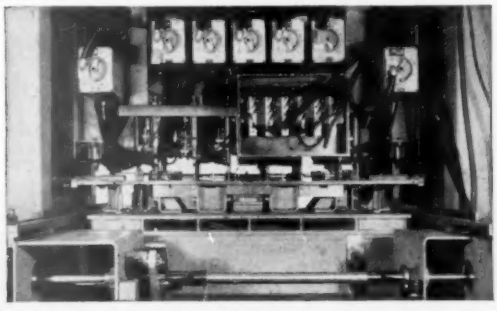
Only Federal can offer single company responsibility in supplying both the mechanical welding press and the welder tooling based on their long experience in both press (Warco) and resistance welder (Federal) manufacture.

There are many manufacturing operations existing today where a mechanical welding press would pay dividends. If you have one of them, why not contact the one company best suited to provide the answer? That's *Federal — First in Resistance Welding*. Welding Press brochure on request.



A variety of welding capsules can be used with these presses. For a changeover in product, simply change the tooling.





Close-up view of welding capsule.

There's no comparison between the old single weld method and this "automated" production line made possible through the Federal Welding Press.

Federal WELDERS®

9967

The Federal Machine and Welder Company

WARREN, OHIO

Warco PRESSES®

Will it fly?

It certainly will! In fact you can find many just like it "flying" through quick-ripening tobacco crops. It's the Case "88," America's newest tobacco harvester. And 100% of the welds are made with A. O. Smith electrodes.

Anniston, Ala. — When this new harvester went into production, J. I. Case Co. production officials knew a major share of costs would be for welding. Therefore, to make sure they were using the best possible procedures, they called on A. O. Smith.

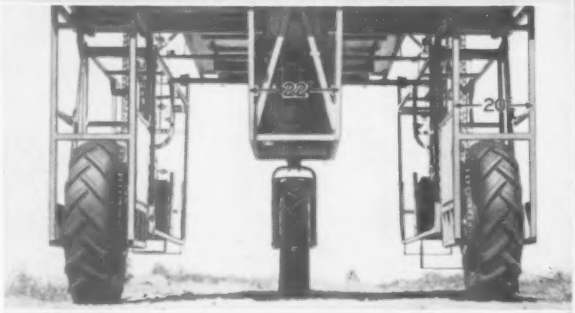
In response, a topflight specialist from A. O. Smith visited their Anniston plant, spent a week surveying their welding procedures.

Result: Welding operations at this plant are running smoothly . . . costs are satisfactory . . . and A. O. Smith SW-14 and SW-65 electrodes are being used for 100% of the welds.

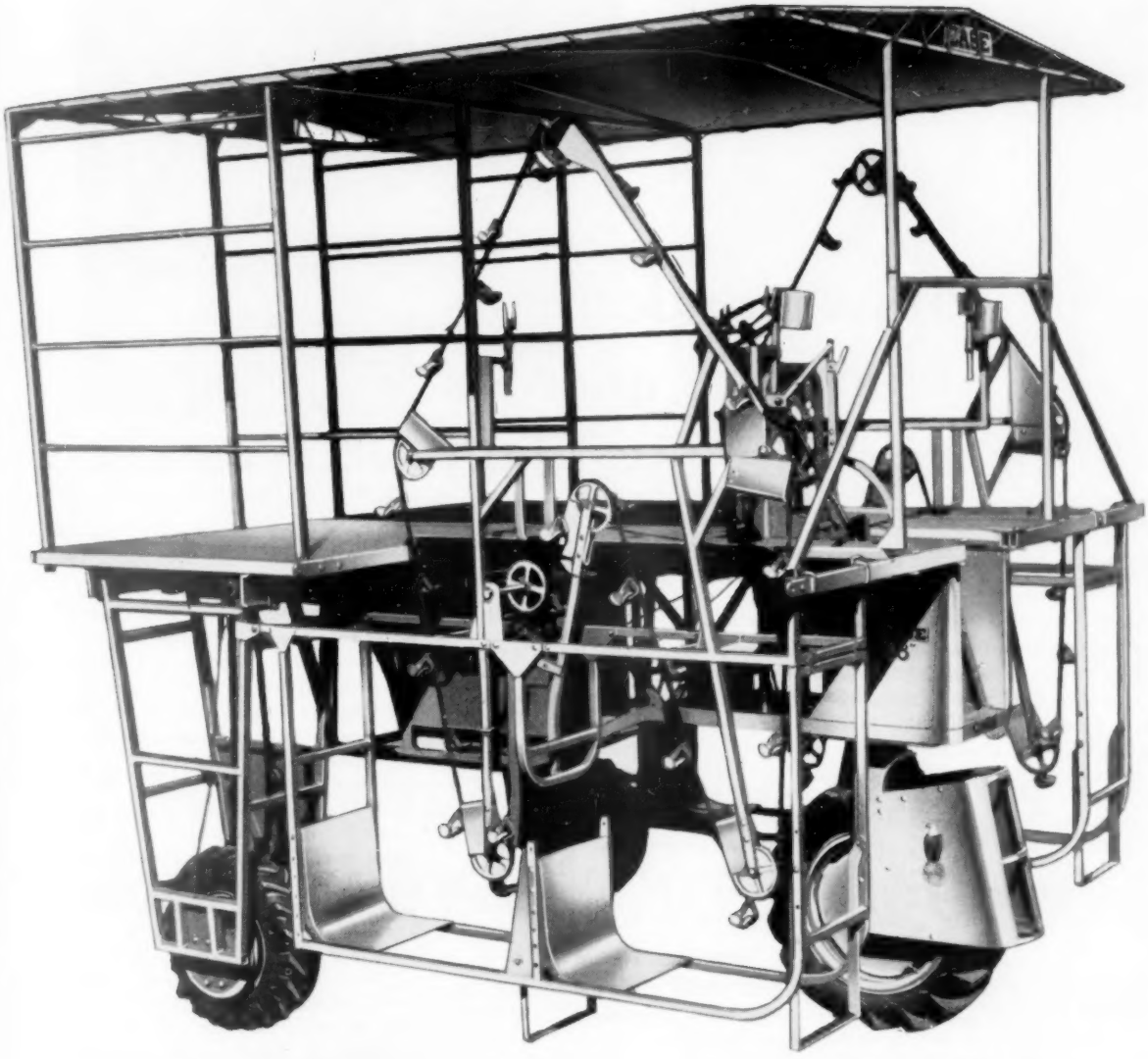
This is one of many examples of A. O. Smith's ability and willingness to help you solve your welding problems — big or small. Why not get in touch with your "man from A. O. Smith" today for all the details.

The man from A. O. Smith
Owen Ford is the A. O. Smith representative who worked with J. I. Case at Anniston. More than a salesman, he's a welding specialist, ready and eager to help you with any of your welding problems.

Here's the Case "88" at work. Terrain it must travel is uneven . . . submits frame to severe torsional stresses and strains. Thus welds must be of unusual strength.



This view of the Case tobacco harvester's undercarriage clearly indicates why. "small area" welds will have to carry heavy loads without failure.



J. I. Case Model "88" tobacco harvester.

Despite absence of bulky structural member, the Case "88" has a great deal of stamina. At work, it carries a crew consisting of six. It is self-powered with a 25hp Case air-cooled engine.

Through research A.O. Smith *... a better way*

A.O.Smith

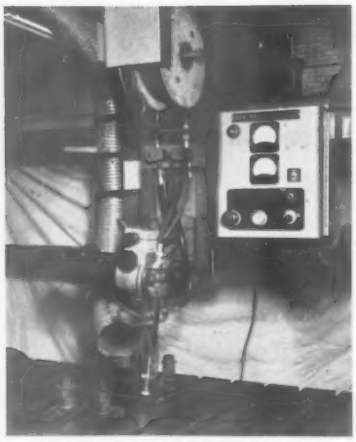
CORPORATION

WELDING PRODUCTS DIVISION

Milwaukee 1, Wisconsin

INTERNATIONAL DIVISION: MILWAUKEE 1, WISCONSIN

Project undertakes electrode analysis for mild steel welding



AUTOMATIC submerged arc welding equipment was used to make test welds in the project.

By Julian D. Carey and Robert D. Mann*

THE welding of mild steel is one of the most promising fields of application for the Mig (metal inert-gas) process. To utilize this process properly, it is important to use a proper combination of electrode and base metal.

A project was undertaken to determine the best mild steel wire electrode analysis for use with 100% carbon dioxide, and with 5% oxygen, 95% argon shielding gases. This analysis is a basis for selecting a standard mild steel welding wire.

To obtain this data, it was necessary to know if some electrodes would be less critical than others with regard to wire feed speed, arc length, travel speed, and welding position. It was also desirable to compare mechanical properties and measure their performance on three basic grades of mild steel—*i.e.*, rimmed, semi-killed and killed.

This article is based upon a paper presented by the authors before a meeting of the American Welding Society.

Electrodes Tested

Six of the most widely used electrode wires were selected to be tested. All were 1/16 in. in diameter and were spooled for this process. Automatic submerged-arc welding equipment was used to make the test welds. Close control over such welding variables as arc length, current, travel speed, wire feed and torch position was maintained.

Commercial grades of steel plate were purchased from the mill for all tests. To maintain uniformity, all plates were low carbon, hot-rolled, pickled and oiled. The three grades used were analyzed. Each electrode was also evaluated.

First, a series of beads was welded on ¼-in plate. These were cross-sectioned and examined for penetration, porosity, contour and surface condition. In addition, they were examined radiographically; where carbon dioxide was used, degree of spatter was noted.

Butt welds were made on ¼-in. plate with and without edge preparation. These were examined radiographically for porosity. Tensile tests were then made on welds which did not show excessive porosity.

FREE BEND TESTS ON RIMMED STEEL

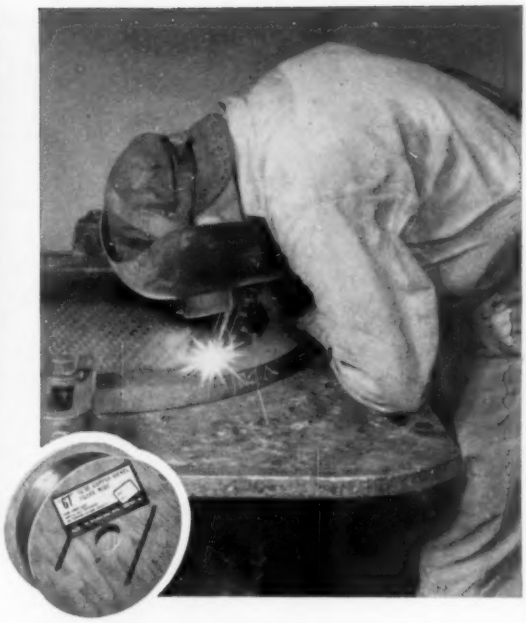
ELECTRODE	100% CARBON DIOXIDE % ELONGATION AT WELD FACE	5% ARGON-OXYGEN % ELONGATION AT WELD FACE
A	50 39	44 45
B	31 31	64 49
C	38 41	40 41
D	24 30	55 43
E	29 70	45 39
F	50 32	45 54

Bend Tests Made

All weld metal test specimens were prepared to evaluate mechanical properties of the electrodes. This test was considered valuable since it showed transfer efficiency of the elements, the effect of multi-pass welding, and true mechanical properties of the deposited metal.

Free-bend tests were made on ¼-in. butt welds to measure relative

For metal arc welding – Inco "137"* 70/30 copper-nickel welding electrode



For inert gas welding – Inco "67"* 70/30 copper-nickel filler wire on spools for consumable electrode process. Also in straight cut lengths for tungsten electrode process.

Weld copper-nickel alloys soundly by all three methods

For oxy-acetylene welding – Inco "47"* 70/30 copper-nickel filler rod and Inco "1"* flux

Take your pick of the common welding processes—

When you use these Inco welding products, you're on your way to sound, ductile, corrosion-resisting welds in 70/30, 80/20 or 90/10 copper-nickel alloys.

Welds of *predictably* good quality! *That's because of the carefully controlled composition of flux and filler metal.*

Inco research makes available detailed procedures for their use.

Send for this new booklet

"Inco Welding Products" describes all the Inco electrodes, wires, rods and fluxes. Gives recommended applications . . . index of Government and Engineering Society specifications . . . information on electrode requirements for various joint designs . . . and much more. For your copy of this useful booklet, just write:

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performance of deposits made with the various electrodes.

A microhardness traverse was made through the weld zone of a carbon dioxide butt weld. This method of hardness testing was used to determine the hardness gradient from base metal into weld metal. It was felt that any increase in hardness, due to carbon pickup when using carbon dioxide, would be observed.

Microscopic examinations were made on joints welded with the various electrodes. No appreciable difference in microstructure was detected between the various electrode wire deposits when used with the same gas.

It was noted, however, that bead contours of welds made with carbon dioxide differed from those made with argon-oxygen. The carbon dioxide weld had a wide penetrating pattern compared to the finger-like penetration of the argon-oxygen weld.

All wires produced sound beads on rimmed, semi-killed and killed plates using both gases. The high silicon wire produced excessive slag with both gases and excessive spatter with carbon dioxide.

Tension Tests

Radiographs of the butt welds on ¼-in. plate showed an appreciable difference in porosity between the electrodes. When these welds were tested in tension, all breaks occurred outside of the weld.

This was considered normal since the higher silicon and manganese content of deposited metal produces strengths greater than those in the base material. In addition, any carbon pickup from carbon dioxide increases weld metal strength.

COMPARISON OF
ALL WELD METAL MECHANICAL PROPERTIES
USING 100% CARBON DIOXIDE AND 5%
ARGON-OXYGEN SHIELDING GAS

COMMERCIAL ELECTRODE ALLOY	ULTIMATE TENSILE STRENGTH, PSI		YIELD STRENGTH, PSI		ELONGATION % IN 2"	
	100% CO_2	5% ARGON-OXY.	100% CO_2	5% ARGON-OXY.	100% CO_2	5% ARGON-OXY.
A	82,700	75,400	69,400	62,800	5	27
B	*	76,250	—	62,925	—	25
C	80,100	77,900	66,900	67,300	20	10
D	108,100	83,500	89,400	70,300	6	15
E	84,500 86,000	82,750 77,700	73,900 73,000	72,600 67,200	18 23	17 21
F	81,490 83,600	74,600	70,900 69,420	63,000	19 16	25

* ALL WELD METAL DEPOSIT TOO POROUS TO OBTAIN ACCEPTABLE TEST BAR.

The mechanical properties obtained from all weld metal tension tests showed that a wide variation in properties exists between electrodes and between shielding gases used. There were differences in elongation for weldments made using carbon dioxide.

Three wire electrodes were very low. One of them consistently produced welds too porous to permit the machining of a test bar. Another, while having good mechanical properties, would not consistently produce porosity-free welds.

The tests narrowed the range of acceptable electrodes to two (E and F on the accompanying tables). It was noted that reasonably good welds were produced with all electrodes when argon-oxygen was used.

Surface Films

The analysis of the two welding wires which performed well on both carbon dioxide and argon-oxygen was studied. A wide variation in manganese content was noted (1.23% for E and 0.88% for F). Both alloys had carbon lower than 0.10%. The silicon was relatively the same, being 0.42% for E and 0.36% for F; the aluminum ranged from 0.02% to 0.01%.

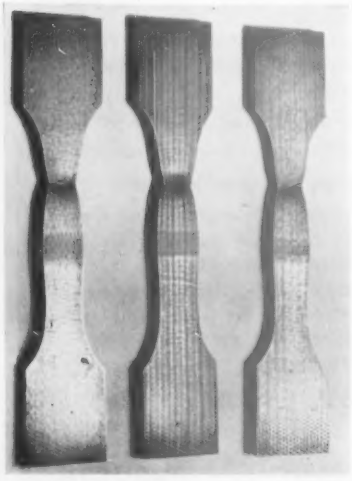
Since the most satisfactory electrodes did not vary drastically in chemical composition from the others, it was felt that the steel-making practice played an important role in determining ultimate performance. To date, no electrode surface chemistry study has been conducted. It is believed that surface films remaining from drawing lubricants play an important role in electrode performance and weld quality.

During the investigation, another important fact was noted when carbon dioxide was used. All wire electrodes produced porous welds when the arc voltage, measured at the torch, was increased above 32 volts. This voltage produced an arc length ⅛ in. above the surface of the base metal.

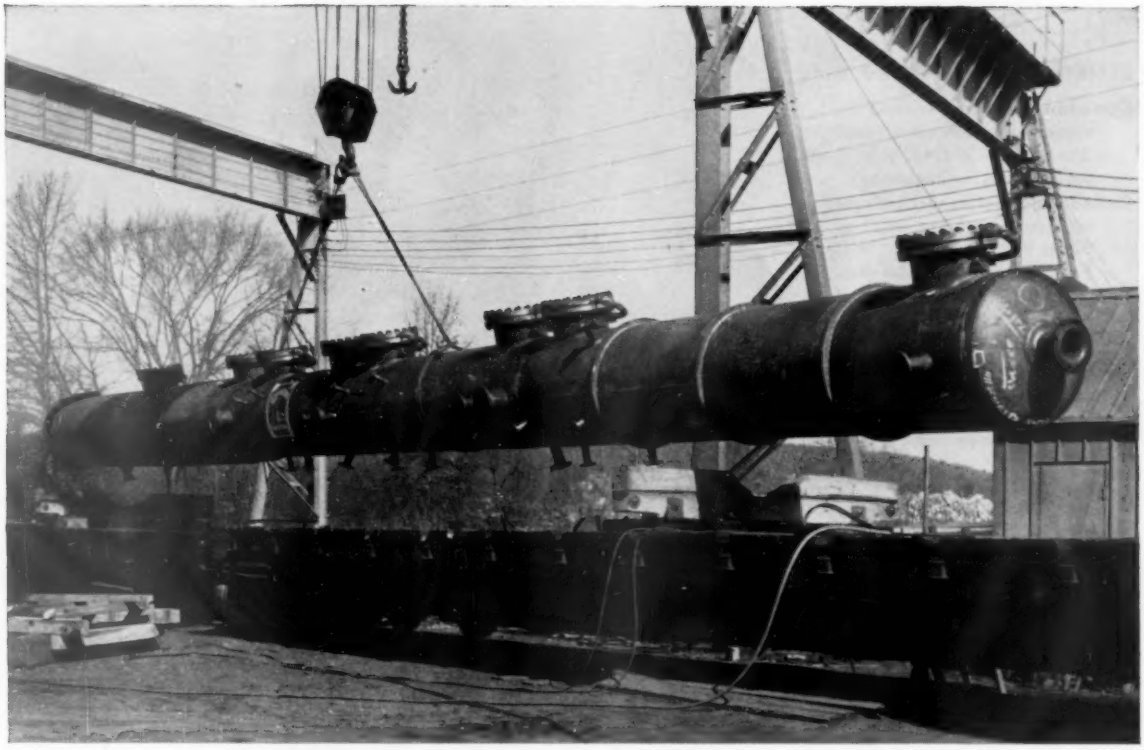
Electrodes used in the test were 1/16 in. in diameter; however, this combination of arc voltage and porosity could change for other wire sizes. In general, the arc length at 32 arc volts is too long for high-quality spatter-free welding. Most carbon dioxide welding with 1/16-in.-diameter electrodes is conducted using lower arc voltages.

This investigation showed that killed and semi-killed steel produced higher quality welds than rimmed steel using both gases. Carbon dioxide shielding produced higher quality welds on rimmed steel than argon-oxygen.

Since only two of the six electrodes tested were satisfactory for use with both carbon dioxide and argon-oxygen, a great need exists for development in the field of mild steel wire electrodes.



TENSILE test specimens (¼-in.) showing fractures in base metal.



Welded with dependable

Downingtown weldors found Arcaloy Type 310 AC-DC the ideal electrode for the many welds in this vessel. Shown above they are working on the final assembly welds between the 410 clad section and the mild steel section.

ARCALOY

STAINLESS STEEL ELECTRODES

DOWNINGTOWN Iron Works, Inc.* used Arcaloy stainless steel electrodes in the fabrication of this 80′ refinery stripper tower. They chose Arcaloy Type 310 AC-DC electrodes for welding the 48″ diameter clad section and for joining it to the 42″ diameter steel section. Fabricated under API-ASME code, this vessel had to have welds of x-ray quality. The Downingtown staff knew that dependable Arcaloy stainless steel electrodes would produce these sound welds.

This stripper tower is typical of the fine products of Downingtown Iron, products that reflect the efficient planning, skilled workmanship and thorough service of this outstanding builder of equipment. Arcaloy stainless steel electrodes were *their* choice—and should be yours, too—for producing high quality weldments.

For complete information on dependable Arcaloy stainless steel electrodes, see your Alloy Rods distributor or write:

General Offices and Plant
Lincoln Highway West • YORK 2, PENNSYLVANIA

Pacific Coast Sales Office and Plant
750 Lairport Street • EL SEGUNDO, CALIFORNIA

*Division of:
PRESSED STEEL TANK COMPANY,
Milwaukee 14, Wisconsin

Alloy Rods Co.

no finer electrodes made . . . anywhere

STAINLESS STEEL WELDING WIRE...

Spooled... layer wound to assure a smooth, even feed. Sizes: .035", .045", 1/16", 5/64" and 3/32" diameters.

Coiled... layer wound on rims for submerged arc welding. Sizes: 1/16", 5/64", 3/32", 1/8", 5/32", 3/16" and 1/4" diameters.

Cut Lengths... straightened and cut wire furnished in 36" lengths for inert arc and gas welding.

Sizes: .035", .045", 1/16", 5/64", 3/32", 1/8", 5/32", 3/16" and 1/4" diameters.

Two factors give

Drawalloy

CORPORATION

WELDING WIRE

best on-the-job performance

WEAR-O-MATIC HARD-FACING WIRE...

Coiled... precision drawn for perfect roundness to insure continuous, smooth feed with any automatic head. Available in six Types for hard-facing applications.

Drawalloy welding wire is a product of two factors—years of experience in the welding industry combined with the best wire mill drawing practices. The result is clean welding wire with the proper finish, temper, diameter tolerance and chemical analysis. It's a wire that produces the highest quality welds continuously—with an easy, sure feed and a constant, smooth arc.

See your distributor or write Drawalloy Corporation, Lincoln Highway at Alloy Street, York 12, Pennsylvania

Drawalloy

CORPORATION

The Wire Mill For The Welding Industry

YORK, PENNSYLVANIA

Between Passes

congratulations!

A certificate of merit has been awarded to *Airco in the News*, the Air Reduction house magazine, by the International Council of Industrial Editors. Airco's colorful publication was one of 84 award winners in a field of 918 entries . . . it placed fifth in its class.

3-2 college program

Colorado College has joined Carnegie Tech in a five-year co-op program leading to both liberal arts and engineering or science degrees. Known as the 3-2 plan, the educational program provides for three years of liberal arts with a major in science at Colorado and two years of engineering or science at Carnegie. This program isn't exactly what we had in mind when we editorialized for a five-year engineering curriculum back in April; but it might be a step in the right direction, if the two years spent in the engineering school consist solely of concentrated theory and shop courses.

more reading matter

A new 5-year book publishing expansion program has been announced by the American Society of Tool Engineers, which now claims 34,000 members. Called for are at least two new major handbooks for production and manufacturing and a revision of the Tool Engineer handbook. Also scheduled are a number of shorter books that will run between 150 and 500 pages. Our boss, Ted Jefferson, is a member of one of the project groups working on the handbook revision.

corrosion data

A progress report put out by the National Association of Corrosion Engineers includes data on welds in equipment used to handle mixed solutions of sulfuric and nitric acids. Association headquarters are in Houston, Texas.

titanium picture

The price of titanium metal sponge was reduced 25 cents per pound recently by the Du Pont Co. The firm expects to double the capacity of its Newport, Del., titanium plant by 1958. Also planned is a fully equipped metallurgical lab in a new building at Chestnut Run, which is near Wilmington, Del. The demand for this lightweight metal is always increasing, and as new methods of welding it are reported, you will read about them in the pages of *Welding Engineer*.

westward ho!

Armour Research Foundation of Illinois Institute of Technology, Chicago, now has a branch laboratory in Tucson, Ariz. Alfred J. Hoehn, of the electrical engineering research department, is in charge.

coming up!

Speaking of reading the latest in *Welding Engineer*—as we were above—our October issue promises to be one you'll long remember. It will be devoted to a "world of welding." We expect to have it in your hands before you entrain, enplane, en-etc., for the Metal Show in Cleveland.

rich neighbor

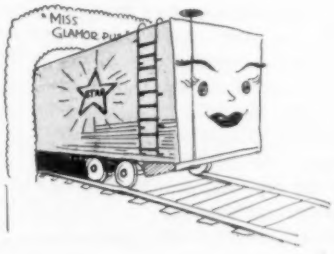
The value of Canada's total metal production during 1955 reportedly exceeded $1,000,000,000. Copper was first with a value of $239,000,000; nickel next with $216,000,000, and gold third with $157,000,000. Others contributing to the total were iron, zinc, ore, lead, silver, pitchblende and platinum metals.

not surprising

Just as this issue went to press, steel wholesalers throughout the country started to hike their prices . . . anticipating a general increase when the steel strike is settled. Increases were ranging between 3 and 5%. Incidentally, the ingot production during the first six months of this year set a new record—63,000,000 tons, about 3,000,000 tons higher than in any previous six-month period.

maldistribution

There is so much being said and printed about the shortage of engineers that we don't intend to belabor you again on this page. However, it is our contention that it is not so much a lack of engineers as it is a case of maldistribution. Too many good engineers and scientists are selling, doing technician's work, etc.



glamorizing box cars

The workhorse of railroading—the welded freight car—is getting the glamor treatment. Pullman-Standard Car Mfg. Co. unveiled its Standardization Caravan July 16 in St. Louis' Union Terminal. The rest of the schedule calls for showings in St. Paul, Minneapolis, Chicago, Cleveland, Washington, D. C., Philadelphia and New York City. The caravan commemorates the 10th anniversary of the first "standardized" box cars and the delivery of the 75,000th car of this type to the Cotton Belt railroad.

Between Passes . . .

mucho film

Radiographers of Isotope Products, which has several offices in the United States and Canada, added up the total footage of film used in the five years the firm has been operating. The total: over 350,000 feet—almost 70 miles—of welds have been radiographed. According to the firm, its gamma experts have radiographed welds of the first atomic submarine; found crevices that could trap nitroglycerine in an explosive company's stainless steel vessel; inspected welded links of heavy anchor chain; provided evidence in a legal action concerning reinforced concrete storage structures, and located a welding flux blockage in the maze of channels through a drilled steel press plate.

let's get together

When are the schedule-makers in our industry going to get together? Within the past two years alone, conflicts have had to be resolved about national convention dates. Last year, the National Welding Supply Association scheduled its annual meeting for May, 1956, then had to move it up to March because the American Welding Society set up the welding show and spring meeting for May. Now, the International Acetylene Association and the AWS have their 1957 meetings scheduled for the same week in April . . . the IAA in Minneapolis, the AWS in Philadelphia. Another change will have to be made, and the IAA will probably be the one that has to make it.* Let's get together, men . . . we don't have so many national organizations in this industry that we can't find time for solo conventions.

x-raying stresses

New information on stresses in metals has resulted from work recently carried out by the National Bureau of Standards. Through use of X-ray diffraction, changes in lattice spacing of crystals were studied—both under load and after release from load. It was found that magnitude and direction of the principal stresses can be computed for a certain load condition in this manner, although the elastic limit has been exceeded. According to NBS, these results should not only increase the practical utility of stress measurement by X-ray diffraction but should also prove useful in basic studies of metal fatigue and corrosion.

**They did! New date: Apr. 1-3, 1957.*

how many?

You might not believe it, but despite the fact that major producers of steel are involved in a strike, there are still more than 60 ingot producers in operation. Many of them are fabricators, like International Harvester, but many of the companies listed by the American Iron and Steel Institute are second-line steel producers not struck.

sell welding now!

It's during times like these that welding should really be sold. Steel shortages accentuate the fact that in most structures, welding is able to effect a savings in steel as compared with other means of fabrication. Often called a "depression-proof" industry, welding uses should be expanded now.

exit: one code

An unfired pressure vessel code has gone by the boards. The American Petroleum Institute and the American Society of Mechanical Engineers have announced discontinuance of their joint code for such vessels, effective the end of this year. It has been in existence since 1931. Reason for abolishment: the ASME pressure vessel code has been broadened and so improved that it now more completely covers the petroleum industry's similar code than the combined API-ASME regulations.

"By gadfry, Hoskins, I believe we have the answer to the absentee problems."

COMING EVENTS

SEPT. 17-21: Eleventh Annual Instruments-Automation Conference & Exhibit, Instrument Society of America, Coliseum, New York City.

SEPT. 19: New England Regional Welding Conference, American Welding Society, New England Mutual Hall, Boston.

SEPT. 20-21: Eastern Zone Meeting, National Welding Supply Association, Hotel Statler, New York City.

SEPT. 24-25: Central Zone Meeting, National Welding Supply Association, Hotel La Salle, Chicago.

SEPT. 24-28: X-ray Diffraction School, North American Philips Co., Inc., Sir Francis Drake Hotel, San Francisco.

SEPT. 24-28: Trade Fair of Atomic Industry, Atomic Industrial Forum, Inc., Navy Pier, Chicago.

SEPT. 25-27: Third Annual Atomic Industrial Forum Conference, "Management & Technology for Atomic Industry," in conjunction with Trade Fair, Morrison Hotel, Chicago.

OCT. 8-12: National Fall Technical Meeting, American Welding Society, Cleveland.

OCT. 8-12: Thirty-eighth National Metal Exposition and Congress, Cleveland Public Auditorium, Cleveland.

OCT. 22-26: National Safety Congress and Exposition, Chicago.

OCT. 29-30: West Central Zone Meeting, National Welding Supply Association, Hotel Nicollet, Minneapolis.

NOV. 1-2: Western Zone Meeting, National Welding Supply Association, St. Francis Hotel, San Francisco.

DEC. 3-4: Southeastern Zone Meeting, National Welding Supply Association, Dinkler-Tutwiler Hotel, Birmingham, Ala.

DEC. 6-7: Southwestern Zone Meeting, National Welding Supply Association, Statler-Hilton Hotel, Dallas.

JAN. 28-31, 1957: Eighth National Plant Maintenance & Engineering Show, Cleveland Public Auditorium, Cleveland.

JAN. 30-31: Midwest Welding Conference, Armour Research Foundation of Illinois Institute of Technology, Chicago.

MARCH 25-29: Tenth Western Metal Congress & Exposition, American Society for Metals, Los Angeles. Congress at Ambassador Hotel; exposition in Pan-Pacific Auditorium.

APRIL 1-3: Fifty-seventh Annual Convention, International Acetylene Association, Hotel Nicollet, Minneapolis.

APRIL 8-12: Fifth Spring and Thirty-eighth Annual Meeting, American Welding Society, Hotel Sheraton, Philadelphia.

APRIL 9-11: Fifth Annual Welding Show, American Welding Society, Convention Hall, Philadelphia.

MAY 13-16: Thirteenth Annual Convention, National Welding Supply Association, Hotel Mayflower, Washington, D. C.

LETTERS .... *from page 14*

factory launched aluminum electrodes with extruded coating on the world market as early as 1942—nearly 15 years ago. In 1951 and 1953 this aluminum electrode, marketed under the tradename of "Alcord," had even been shipped to various American firms.

Oerlikon Machine Tool Works
Buehrle & Co.
Zurich, Switzerland

Welding education

Dear Sir:

The editorial in the May issue is outstanding. Welding Engineer has hit on the perfect solution. Everyone that I have talked to about it is quite excited about it. If this idea should go over, and I can't see why not, it most likely would spread to other fields and so solve a lot of problems.

Now I have another suggestion. The welding clinic articles are of great interest to me. In fact, I have a number of them mimeographed and use them in my classes. I wonder whether it would be possible to put them all in book form? I have a number of inquiries from my students on this matter.

John H. Forrer
North Dakota Agricultural College

Dear Sir:

The plan, stated in the May editorial, for the establishment and operation of the Foundation for Education in Welding has a constructive and necessary aim. Its success would depend on the extent to which a large fraction of the affected industry accepts it and wholeheartedly supports it.

If even a few important members of the industry refused to accept it, many other organizations would feel themselves to be at an economic disadvantage, and the plan might decay or disappear.

I hope industry will give this plan the support which it merits.

Dr. Alfred N. Goldsmith
New York. N. Y.

The distaff side

Dear Sir:

Thought you might be interested in hearing from one of your feminine readers.

I'm sure you are proud of your magazine. Our copies are filed and used over and over by our customers as well as our own personnel.

Faye W. Wyatt
Mobile Welding Supply Co., Inc.

the secret

of stable delivery pressure in a low cost regulator

This little engineering gem above gives the new GASWELD R-90 Series regulators two-stage performance—at *single-stage* regulator cost!

The "cartridge" control unit maintains absolutely constant delivery pressure from full to empty cylinder. Time-taking regulator re-adjustments are completely eliminated. Cartridge is instantly replaceable, too—without the regulator ever leaving the cylinder, if necessary.

Other features like the clear, easy-to-read dial and non-flammable safety filter make the new GASWELD R-90 America's big regulator buy—for every welding or cutting job.

Made and guaranteed by Liquid Carbonic—world famous for quality. See the R-90 and the complete line of fine GASWELD regulators at your nearby GASWELD dealer's.

LIQUID CARBONIC also produces Oxygen, Acetylene and other commercial gases, including CO_2 in all its forms, for industrial use.

Liquid

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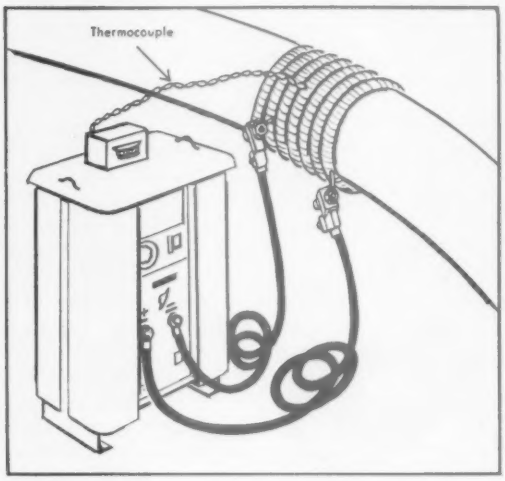
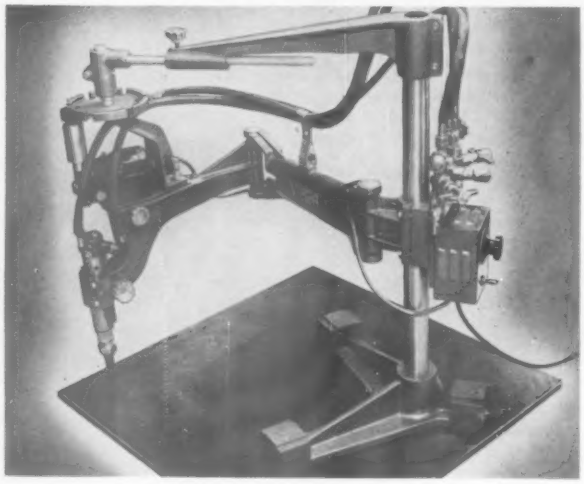
new products . . . . . USE CARD ON PAGE 99



SCHEMATIC drawing shows complete hookup of electrical resistance heating element for preheating, stress relieving of pipe welds.



LIGHTWEIGHT shape cutting machine is accurate, easy to handle. Magnetized feet use stock being cut as working base.

Heating element

ELECTRICAL resistance heating element is claimed to make preheating or stress relieving pipe welds easier and more precise. The element, known as "Heat-O-Coil," is a length of small diameter resistance wire. The full length of the wire, except for several inches on each end, is strung with ceramic ball and socket beads.

Each end of coil is formed into small ring. After wrapping coil around welded section of pipe, the two ends are connected to terminals on welding machine. Thermocouples are inserted under coil and connected to indicating pyrometer. Section is then wrapped with asbestos covering. Welding generator is then set at necessary amperage. When desired temperature is reached, generator is adjusted manually to hold heat.

The "Heat-O-Coil" is available in 1/8 in. coil, standard length of 25 ft, for large diameter pipe; 1/16 in. coil, standard length of 10 ft, for small diameter pipe. *Arcos Corp.*

Circle No. 1.

Welding torch

LIGHTWEIGHT welding torch has welding range from 32 gage to 3/8 in. thick. It is for production welding aircraft and small parts manufacture and for repair and maintenance in sheet metal shops, etc.

The small size and light weight make the "W-120" suitable for hard-to-reach spots, states the manufacturer. Forward valves permit operator to adjust pressures with same hand used to hold torch. Nine welding heads may be used with the "W-120" giving a stable flame, with full control of heat output. They snap-in gas-tight by means of O rings, can be changed quickly. Torch can be adapted for cutting iron and steel up to 2 in. thick with the "CW-120" cutting attachment. *Linde Air Products Co.*

Circle No. 2.

Welding bench

STEEL welding bench "No. 9850" is equipped with bench drawer (18 by 22 by 5 in.) and shelf with partitions to hold electrodes. Bench top is 36½ by 36½ in., which may be filled with fire bricks. Fire bricks *not* furnished.

Overall height is 33⅝ in. Legs are pressed steel. Cylinder lock or padlock attachment for drawer is also available. *Industrial Bench & Equipment Mfg. Co.*

Circle No. 3.

Shape-cutting machine

PORTABLE "Duplicutter" shape-cutting machine is claimed accurate while rugged. Termed "DC-2000," machine can be used in variety of locations for production runs or for one part. Smooth cuts can be made and production tolerances can be held to ±1/64 in., claims manufacturer.

Piercing hole can be started either inside or outside cut so cut will be free of initial hole. Powerful permanent magnet in template follower adheres tightly to template. Full range of speeds is obtained by adjusting rheostat on main support. Machine can cut circles up to 19½ in. diameter, rectangles to 12 by 35 in. Equipped with special torch type "FG-5" which can accommodate tips up to and including size 5; cuts metal up to 8 in. thick. *Victor Equipment Co.*

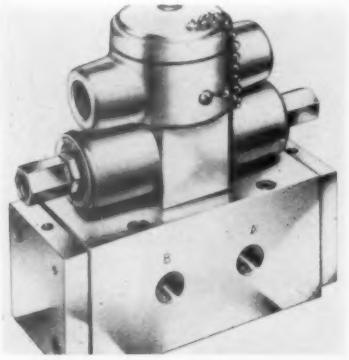
Circle No. 4.

RW transformer

RESISTANCE welding transformer "Power-PaK" is compact unit, light in weight. Unit is positive insulated, designed to be cooler in operation. Tap switch is said to be oil, water and dirt free. Transformer has quick primary disconnect plug adaptable to other transformers.

The transformer is available in three basic models: Type "Ar," 50 kva, type "AT," 60 kva, type "AW," 70 kva. Special ratings are available. *Kirkhof Mfg. Corp.*

Circle No. 5.



Control valves

SERIES of solenoid and master air valves are for three and four-way air operation. The "Flo-Line" valves are for controlling air cylinders and other air operated devices.

Seals are said to eliminate damage from external grit and moisture. Bubble-tight aluminum spool is sealed by O rings. Sizes are 1/4, 3/8, 1/2, 3/4, and 1 in. *Hanna Engineering Works.*

Circle No. 6.

Abrasive gun

SAFETY air gun, used for blowing dust or chips from work, is named "Guardair." The gun may be used in any application where air pressure is now used for blowing work clean.

A central air jet cleans area; a second jet of air, in shape of a cone, provides a protective shield of high pressure air, preventing debris from flying upward. Operation is by easy grip trigger. Gun has leakproof valve; force of air jets is regulated by pressure on trigger. *Hydraulic Mfg. Co.*

Circle No. 7.

Silver brazing

WEIGHT reduction is claimed major advantage of silver brazing alloy being produced in new form—expanded and rolled strip. Expanded strip may weigh only 1/3 as much as solid strip of same cross-section thickness. Basis for new meshed alloy is conventional solid strip. It is first expanded, then rolled to specified uniform thickness.

High fluidity of molten silver brazing alloy is said to insure thorough wetting of joint. Flow to joint areas will not be affected by discontinuous surfaces, claims the manufacturer. Aviation assemblies normally assembled by brazing should profit from use of this meshed alloy. Available in precision thicknesses down to 0.003 in. and strip widths to 12 in. *Handy & Harman.*

Circle No. 8.

Phoson solves "hidden joint" assembly brazing problems!

Everyday . . . this leading *manufacturer PHOSON brazes over 5400 hard to see and reach copper joints. Even though hidden deep down in air conditioning unit assemblies, "leaker" rejections are less than ½ of 1%!

High capillary attraction at low temperature, without flux, make United's Phoson 6 perfect for such tough "in close" brazing jobs.

Copper U-Bend Coil connections, too, are brazed best with Phoson 6 brazing rings making high-volume automation easy, effective and profitable.

For all types of hand fed or automatic copper brazing, Phoson 6 has every desirable characteristic you want . . . high capillary attraction, lowest possible brazing temperature, greatest resistance to vibration and lowest possible cost.

*Name on request

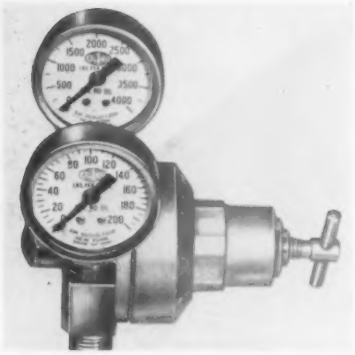
Contact your United Welding Supply Distributor or write . . .

Permanently United

UNITED WIRE AND SUPPLY CORPORATION

PROVIDENCE 7, RHODE ISLAND

COPPER, BRASS, ALUMINUM WIRE AND TUBING • BRAZING ALLOYS



Regulators

INVERSE oxygen and acetylene pressure regulators are known as "Series 8000." They are designed to meet needs of smaller metal fabrication shops.

Regulators are compact—two-gage type measuring 4½ by 4½ in. and weighing 2 lb, 4 oz; single gage measuring 3½ by 5½ in., weighing 2 lb, 1 oz. Regulator body is machined brass forging, spring case is zinc die casting. Gages have crowned, clear crystals for maximum readability. *Air Reduction Sales Co.*

Circle No. 9.

Welding counter

LOAD cycle counter is for use in automatic operations where there is a change in power used to perform the work cycle. It is claimed ideal for automatic welding, induction heating, grinding, polishing.

By counting changes in work cycle power, the "Ram" counter mounted on or near welder in operation, provides accurate count of pieces produced or operations performed. Simultaneous telemetering (requiring counters only) may be added at one or more remote control locations, when desired. A small cabinet-enclosed unit counter can count actual pieces to 999,999; can be reset at any time. Power consumption is 25 watts. Speed: to 1,000 counts per minute. Impact and magnetic (proximity) actuated types also available. *Ram Meter, Inc.*

Circle No. 10.

Tube cut-off

FAST clean cutting tool is for use in shearing pipe and tubing. Depending on length and wall thickness, approximately 1,000-2,000 pieces of pipe or tubing can be handled per hour, states manufacturer.

Blade can make 10,000 to 15,000 cuts—the die 25,000 to 35,000 cuts—before resharpening is necessary. All blades and blocks are interchangeable. The "Vogel Cut-Off" comes in three standard sizes to accommodate tubing up to and including ½ in. OD by 3/32 in. wall, up to and including 2 in. OD by ⅛ in. wall, and up to and including 3 in. OD by 3/16 in. wall. *Vogel Tool & Die Corp.*

Circle No. 11.

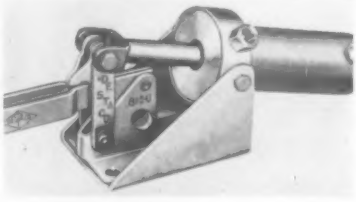
Radiographic unit

VERSATILE unit is for radiographic inspection of pressure vessels, piping, castings, etc. The "Series 50 Multitron," is designed for panoramic exposures where several specimens are arranged around the source and shot simulataneously, and internal exposures where the source is positioned within a cavity of the specimen and the film placed around the outside.

The unit can accommodate four different radioactive sources of Cobalt 60 and Iridium 192 or up to four different strengths of the same source. Strong sources of isotopes may be exposed at distances to 50 ft from operator with safety, states manufacturer.

Unit is portable, weighs 800 lb, and requires no outside power source. Mechanical indicator shows position of source; locking device prevents exposure when not in use. *The Budd Co.*

Circle No. 12.



Hydraulic clamp

TOGGLE clamp is air-operated. Known as "Clamp-omatic," clamp is said to be rugged, compact unit providing positive, split-second clamping in multiple or single unit use.

Clamp is available in two styles: "Model 810-U" with U bar for vertical and lateral adjustment of pressure spindle (illustrated) and "Model 810-S" with solid bar and bolt retainer.

Toggle clamp has expectancy of 400,000 cycles under normal operation, air cylinder has expectancy of 3-5,000,000 cycles. Air cylinder bore is 1½ in. with stroke of 2¼ in. Clamp is 12 in. long by 5⅜ in. high by 3¼ in. wide. *Detroit Stamping Co.*

Circle No. 13.

Abrasive wheel

SMALL "PG" wheel is designed for polishing metal with portable hand tools. Wheel is composed of die-cut pieces of coated abrasive cloth, bonded with resin and locked into a hub.

The "PG" wheel can be used on portable grinders, flexible shaft equipment or small bench-type grinders. Available in 6 to 10 in. diameters, with 1, 1½, 2 and 3 in. face widths and an 11-in. diameter, 2, 2½ and 3-in. face widths. Wheel is made with aluminum oxide or silicon carbide mineral on a cloth backing, grits from 50—320. *Minnesota Mining & Mfg. Company.*

Circle No. 14.

Welder

ENGINE driven welder has battery start and direct coupling between engine and generator. Available in 300 and 400 amp models, welder includes reversing switch, battery start and side panels. Built to withstand heavy duty service, welder is constructed of extra heavy steel.

Both two and four-wheel trailers are available—two-wheel has small, retractable 12 in. diameter wheel on two-bar to simplify handling. Gasoline-driven models have engines rated 54 hp at 2,150 rpm.

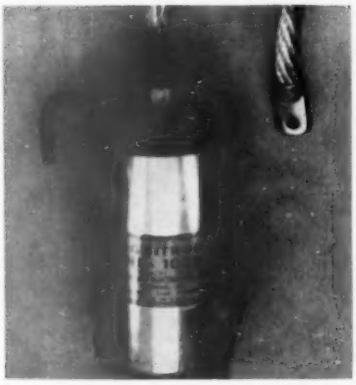
Both models have duty cycle of 60%, rated temperature rise of 50 C, operate at maximum rpm of 2,150. The 300 amp unit, designated "30AG," has welding range of 60-375 amp; electrode capacity of 3/32 to 5/16; the "40AG," rated 400 amp, has 80-500 amp operating range, electrode capacity of ⅛ to ⅜. *General Electric Co.*

Circle No. 15.

Voltage booster

PORTABLE electric power unit, the "Portopower" voltage booster, is designed to deliver additional voltage. The booster has a voltage meter for checking delivered operating power, a five-position voltage increase switch, each position providing a 10-volt step-up in voltage output. Total increase available is 50 volts. *Portopower Division.*

Circle No. 16.



Thermal ignitron

METAL, water-cooled, mercury pool ignitron "NL-1022" is designed especially for frequency-changer resistance welders. Ignitron is of copper cooling coil construction with thermostat mount. Cooling coil is self flushing. Mercury-pool cathode permits tube to handle extremely high currents on an intermittent basis.

Thermostats are available for protection of ignitron or for water saving. The "NL-1022" is rated at 1,500 amp maximum peak current at 1,200 maximum peak inverse and forward volts; 1,200 maximum peak amp at 1,500 maximum peak inverse or forward volts. It is equivalent to "NL-5822" but has addition of thermostat mounting plate. *National Electronics, Inc.*

Circle No. 17.

Set-up blocks

ALUMINUM alloy set-up blocks, multi-step type, are said to withstand great weight under clamping pressures. Blocks are said to reduce machine set-up time while protecting machine tables from scratches and nicks.

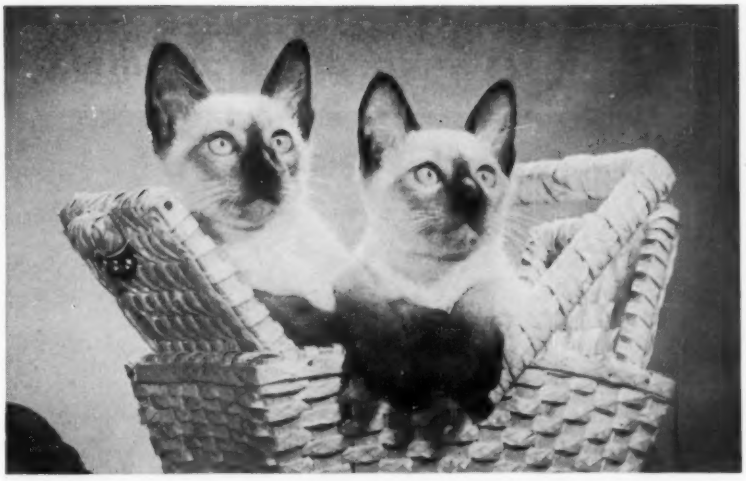
Blocks can be used on jig borers, boring mills, drill presses and milling machines, planers. They hold work from 0-3 in., can be mounted on 3 in. high risers and thus pyramided to any desired height. Blocks are packaged in sets of 4: 2 blocks and 2 risers. *Jergens Tool Specialty Co.*

Circle No. 18.

Salt bath furnace

SALT bath furnace can be built to any size or capacity with welded steel, ceramic or alloy pot. Immersed alloy electrodes with water-cooled terminals prevent conduction of heat to transformer. Low operating voltage eliminates shock danger, states manufacturer. *Hevi Duty Electric Co.*

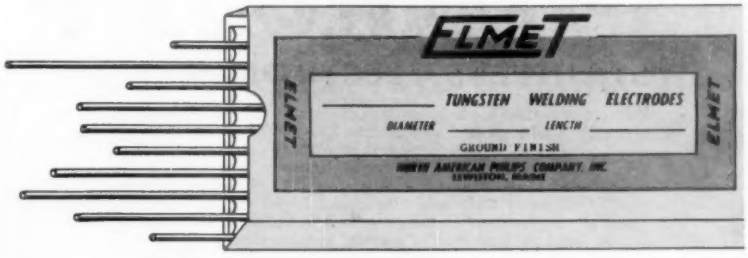
Circle No. 19.



ALIKE AS TWO ELMET ELECTRODES

Nature does it without even trying, but on the production line it takes a lot of human skill to attain absolute uniformity. In the making of Elmet tungsten electrodes, however, the result is well worth the extra effort. For Elmet electrodes are completely uniform, not only in surface finish and dimensions, but more important, in their composition, characteristics and physical structure. This means that, with Elmet, you get consistently superior performance from electrode to electrode with a minimum in readjustment of equipment and voltage.

Elmet pure tungsten and thoriated tungsten electrodes are furnished in cleaned finish and in the mirror-smooth centerless ground finish. They are available in packages of 10 in all standard diameters from .040" to ¼" and from 3" to 18" in length.



Why not place a trial order with your distributor today, or use the coupon below to obtain full information and an informative folder on tungsten electrode welding.

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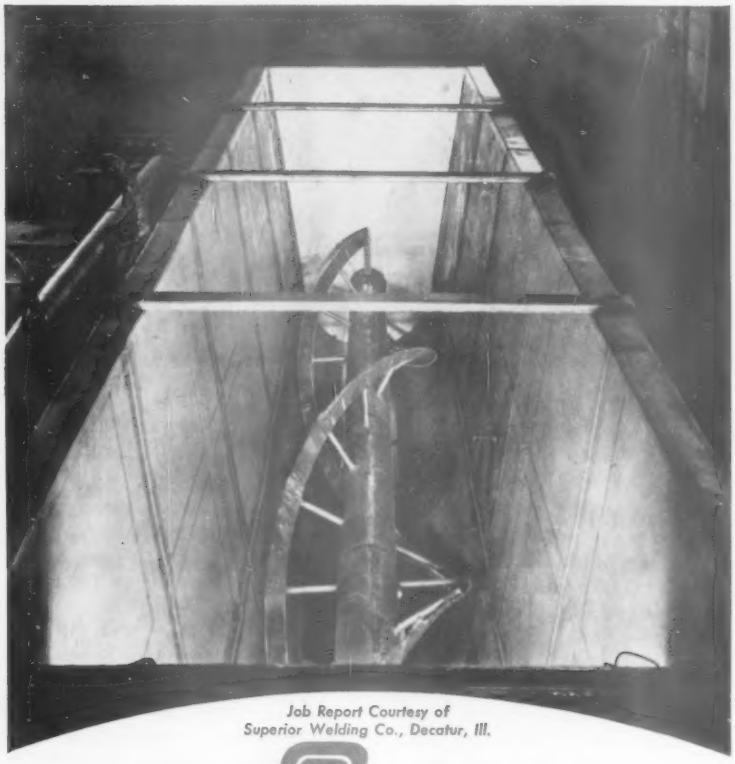
How to get longer service from stainless welded equipment

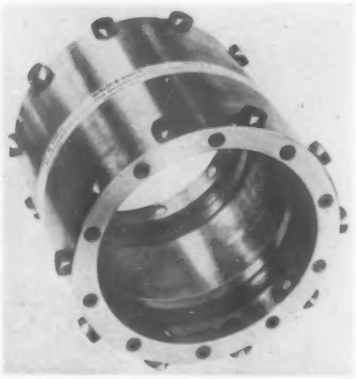


Job Report Courtesy of Superior Welding Co., Decatur, Ill.

WELD WITH ARCOS

STAINLESS ELECTRODES

Processing certain foods in equipment such as this corn germ separator often releases acid by-products. These by-products, although weak, often corrode the equipment and contaminate the food unless the equipment is made of the "right" stainless. For welding the trough and agitator sections, two types of ARCOS Electrodes were used—Chromend KMo and Chromend 25/20 Mo respectively. These electrodes meet all the essentials: trouble-free welding, unbroken weld performance in service, and freedom from contamination. ARCOS CORPORATION, 1500 South 50th Street, Philadelphia 43, Pa.



Packing ring

SPECIAL high temperature resistant packing ring permits welding hot pipeline while pumping through it. Packing ring is made of an asbestos-mica compound, and molded into "Weld-End" coupling. Packing ring can be used on pressures to 1,500 psi at 1,000 F on oily steam pressure.

Pressure - temperature applications may be determined by ratings of standard codes for mild carbon steel pipe. Special couplings of carbon-molybdenum or chromium-molybdenum steels are available. *The Pipe Line Development Co.*

Circle No. 20.

Electrode

BRONZE nickel-aluminum electrode is for welding of nickel - aluminum bronze cast ship propellers and turbine runners. In spooled form, "Ampco-Trode 46" is for use with the inert-gas consumable process. The electrode is said to produce a deposit of high tensile strength, yield strength and ductility.

It is available in 0.045, 1/16, 5/64, 3/32 and ⅛-in. diameter, either spools or rims for Mig (metal inert-gas) welding. It can also be supplied as coated electrode for metal arc, coated 36-in. filler rod for carbon-arc, 36-in. bare filler rods for Tig (Tungsten inert-gas) welding. *Ampco Metal, Inc.*

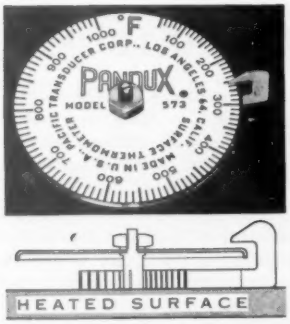
Circle No. 21.

Pressure transmitter

ABSOLUTE pressure transmitter will measure in ranges as low as 0-5 mm Mercury Absolute. It will transmit the measurement as a 3-15 psi pneumatic signal to an automatic controller or receiver.

The "Metagraphic" absolute pressure transmitter can handle pressure ranges from 0-5 mm Hg to 0-760 mm Hg. It transmits a universal 3-15 psi pneumatic signal. *The Bristol Co.*

Circle No. 22.



Surface thermometer

SPOT check surface thermometer "Model 573" can be laid on metals to be welded. Made of stainless steel, it has range of 50 to 1,000 F. It is easy to read, compact, fast-operating —within 60 seconds thermometer will reach stability, it is said.

Thermometer is for determining temperatures on hardfacing welds, preheating of metals, watching of maximum temperatures on metals such as manganese. Also reads ambient temperatures in furnaces, ovens and other enclosed spaces. It can be used in noncorrosive liquids to 1,000 F. Comes calibrated to within ±2%. Diameter is 1¾ in. overall, weighs ⅓ oz. *Pacific Transducer Corp.*

Circle No. 23.

Abrasive buff

PLEATED sectional abrasive buff is for ferrous and non-ferrous metals. Buff is made of specially-treated biased cloth, impregnated with abrasive grains bonded throughout.

Abrasive buff can be altered by conventional spacers to adjust cutting action and to provide greater coverage. Normal side supports and flanges can be used. A variety of grit sizes are available. *The Carborundum Co.*

Circle No. 24.

Rust protection

RUST preventive spray is for use on tools, molds, dies, instruments, nested metal parts and machinery. Known as "Rust Chek," the new compound is packaged in 12-oz. spray container. A can provides, it is claimed, 80 sq ft coverage in form of clear, dry, waxy film to a thickness of 0.0005.

With exception of precision instruments requiring critical tolerances, film need not be removed when parts are used. The film is worked off in using. Spray is claimed *not* to absorb dust and dirt; can be also used outdoors where permanent coatings are needed. *Eastern Aerosol Products.*

Circle No. 25.

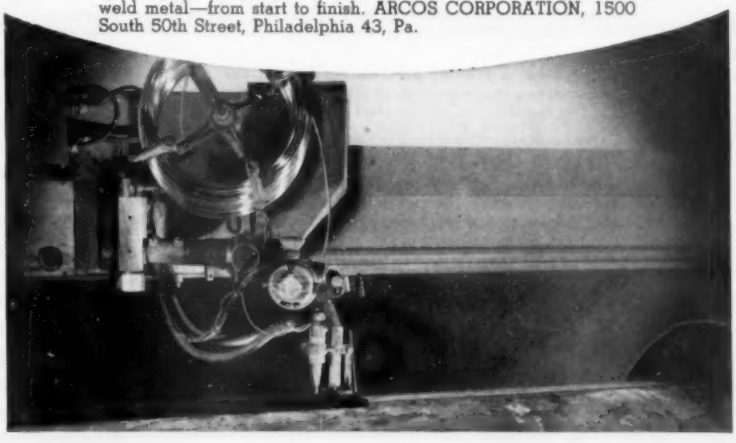
More proof . . . how to get *consistent* results from submerged arc welding

Courtesy of CF Braun & Co
Engineers and Constructors, Alhambra, California

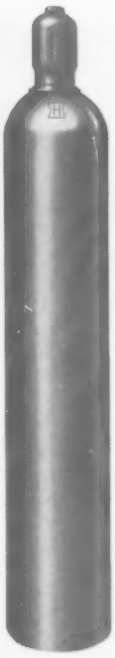
WELD WITH ARCOS

STAINLESS COILED WIRE

Unfailing strength and resistance to corrosion at elevated temperatures are vital in the welds of this massive 14 ft. diameter, 30 ft. long catalyst pressure vessel. All seam welding of the 1¼ Chrome ½% Moly plate was submerged arc welded with Arcos Chromar *welding quality* wire. Arcos Chromar wire—like every Arcos filler metal product—can be used with confidence on the most critical jobs. Start with Arcos and be sure of uniform dependable weld metal—from start to finish. ARCOS CORPORATION, 1500 South 50th Street, Philadelphia 43, Pa.



How long should a gas cylinder last?



Industry expects 25 to 30 years or more of useful life from high pressure gas cylinders. This expectation is based on long experience with cylinders made by Harrisburg Steel Corporation and its subsidiary, Taylor-Wharton Iron and Steel Company.

Don't let your desire for lightness cause you to use cylinders with walls so thin that they pass I.C.C. inspection without an adequate reserve. Will such cylinders last 25 years? No one knows.

Extreme uniformity of wall thickness in our cylinders makes it certain that they carry no excess weight. They are, therefore, as light as is consistent with *sound design and safety.*

SEND FOR A CATALOG AND PRICES.

More than a century in Harrisburg

Harrisburg Steel Co.

Division of Harsco Corporation — Harrisburg 8 Pennsylvania

NOW... make your own

• WATERPROOF
• SHOCKPROOF • NEOPRENE INSULATED

CABLE CONNECTORS

Now, for the first time, a 110-volt portable molding kit that anyone can operate, to seal cable connectors in waterproof, shockproof, neoprene insulated sleeves . . . in the plant . . . in the field . . . in minutes!

Tapered sleeve connection assures a waterproof joint when connector is locked. Low cost . . . rugged . . . simple . . . economical . . . factory and field test proven.

New kit, with its heavy-duty crimping and vulcanizing press plus 4 parts, are all you need. Eliminates soldering, short circuits, flexing and breaking of cable strands, down-time, wear, breakage and corrosion. Connectors employ a positive lock for high conductivity yet can be taken apart instantly.

Get the facts today on this revolutionary new product. Write for Catalog No. 131, or ask your welding supply distributor.

cam-lok DIVISION

EMPIRE PRODUCTS, INC., P.O. Box N-98, Cincinnati 36, Ohio

NEW PRODUCT BRIEFS

Neutral nontoxic nonflammable solvent is said to clean, degrease and rustproof metal surfaces in one operation. *Harry Miller Corp.*
Circle No. 26.

Conductive shoe is claimed to discharge static electricity as rapidly as it is generated. Conductive vinyl soles resist wear, are chemically resistant. *Bates Shoe Co.*
Circle No. 27.

Nonskid abrasive aluminum tread plate provides sure footing even when covered with oil, grease or water, claims manufacturer. It can be shop fabricated. *Aluminum Co. of America.*
Circle No. 28.

Precision measurement of flatness is provided by "Mono-light" portable unit. Model has helium lamp light source; can measure to 1 light band (0.0000116) or less, states manufacturer. *Spitfire Tool Co.*
Circle No. 29.

Adjustable speed "Gyrol" fluid drive is available from 1-25 hp. Units suited for automated use where minimum maintenance, automatic speed adjustment and accuracy of repeat speed settings are desired. *American Blower Corp.*
Circle No. 30.

Precision measurer and calculator, the "Caliputer," combines functions of slide rule vernier caliper and vernier depth gage and computer. Pocket size, it is made of stainless steel, 4¾ in. long. *Caliputer.*
Circle No. 31.

Kit of deep-cut hole saws has two mandrels in all steel box. Saws (1 1/16 to 2 9/16 in. diameter) have sharp cutting teeth, four to inch. *Millers Falls Co.*
Circle No. 32.

Heavyduty protective skin cream, "Solucone," contains silicone as protective agent in vanishing base. This provides barrier protecting skin against external irritants. *Soluol Laboratories, Inc.*
Circle No. 33.

Muffler for air-operated equipment, termed "Automuffler," has 4-port deflector, combined with internal acoustical resonator, said to cancel noise. *Allied Witan Co., Inc.*
Circle No. 34.

30 YEARS AGO

(Taken from *The Welding Engineer* of August, 1926)

The Burke Electrical Co., Erie, Pa., has appointed Louis D. Moore, St. Louis, Mo., and W. C. Fletcher Co., Indianapolis, sales representatives for arc welding equipment.

— 30 YEARS AGO —

W. E. Van Dresser has opened an office and warehouse in Minneapolis for distribution of welding equipment and supplies. He has been district manager of the Lincoln Electric Co., Minneapolis office.

— 30 YEARS AGO —

The Welding Equipment Co., Chicago, was recently established as a distributor of welding equipment and supplies. J. F. Romadka is manager. W. A. Owens, formerly with C. H. Hollup Corp., has joined the new firm.

— 30 YEARS AGO —

Charles J. Murray has joined the staff of Oklahoma Construction Co. He was formerly associated with Linde Air Products Co. Mr. Murray will organize a new division for Oklahoma Construction which will engage in welded pipe line construction.

— 30 YEARS AGO —

Construction has begun for an addition to the plant of Harris Calorific Co., Cleveland. The move was necessary to provide additional manufacturing facilities after consolidation of Harris Calorific and United States Welding Co., Minneapolis.

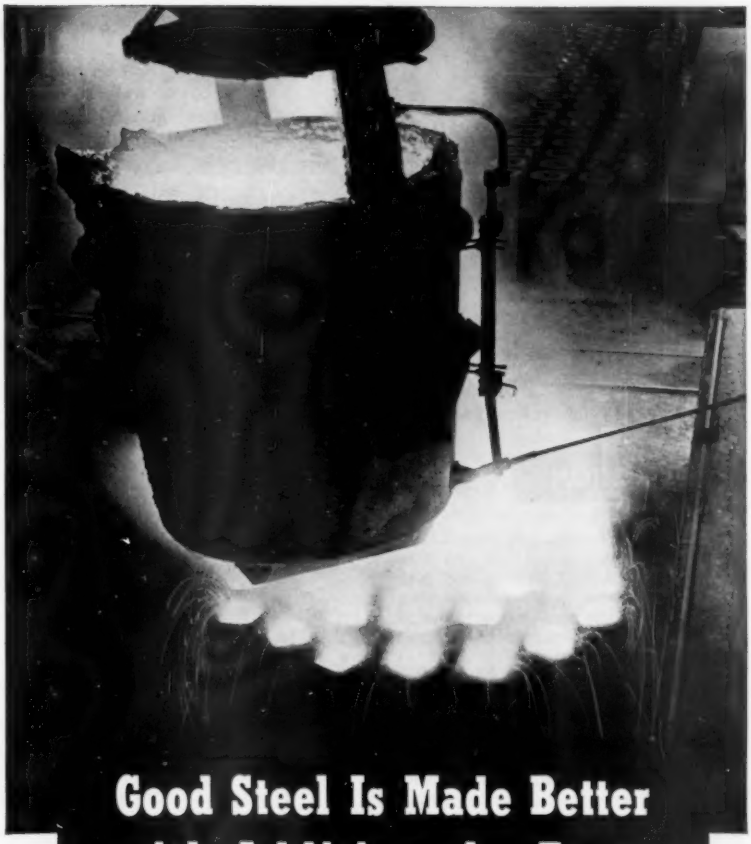
— 30 YEARS AGO —

R. K. Randall, director of the welding school, Cleveland YMCA School of Technology, is taking advantage of the vacation season to visit trade schools in the East.

— 30 YEARS AGO —

Westinghouse Electric Corp., Pittsburgh, plans to erect two arc-welded structural steel buildings—a one-story engineering laboratory at the East Pittsburgh works and a five-story mill type building at the Sharon works. The Sharon structure is claimed to be the first such structure in the world with all joints and members designed for arc welding.

SUCCESS *is counted sweetest by those who ne'er succeed.—Emily Dickinson*



Good Steel Is Made Better with Additives by Foote

Used in comparatively small quantities, Foote fluxes and alloying agents impart properties that not only improve the quality, but increase the workability of many types of steel. These diversified Foote products range from ferro alloys to such specialized additives as Rimex® for rimming steels . . . Manganese Sulphide for free-machining steels . . . and Electromanganese® (99.9% pure manganese), widely used in the manufacture of stainless and alloy steels, as well as special resulphurized free-machining steels.

In production, research and technical service . . . Foote maintains leadership in the supply of fluxes and alloys for the steel industry as well as raw materials used in the manufacture of welding rod coatings.

Descriptive literature on any of the products mentioned will be sent upon request.

Foote

FOOTE MINERAL COMPANY

453 Eighteen West Chelten Building, Philadelphia 44, Pa.

RESEARCH LABORATORIES: Berwyn, Pa.

PLANTS: Exton, Pa.; Kings Mountain, N.C.; Knoxville, Tenn.; Sunbright, Va.

AIRCO

WELDING and BRAZING Hints

PROBLEM:

Brazing and Braze Welding Rod Selection

SOLUTION:

Airco #22 Manganese Bronze Rod. A general purpose rod that should be in every welding shop where high strength brazed joints are required. Flows smoothly and produces sound joints on maintenance work when used with either Airco Marvel Flux or Airco High Test Liquid Flux. Airco #22 is also available with flux already coated on the rod to insure positive base metal protection.

Airco #20 Bronze Rod. Ideal for braze welding of steel, cast iron, malleable iron, copper, and dissimilar combinations of these metals. Airco #20 is available as a pre-coated rod using Hi-Test Flux. When this rod is purchased bare, either Hi-Test or Marvel Flux can be used for high strength welded joints.

Airco #27 Low Fuming Bronze Rod. For the brazing or braze welding of steel, cast iron, or bronze. Low fuming characteristics of this rod increase its applications in restricted areas. Recommended fluxes for use with Airco #27 are Airco Hi-Test or Marvel Flux. Flux coated rods also available.

Brazing and Braze Welding Flux. A good brazing flux cleans the joint, removes oxides created by heating, and picks up impurities in filler metal. Airco Hi-Test Flux, when properly applied, will accomplish these jobs.

Send for this free catalog!
You'll find here the finest rods and fluxes for joining both ferrous and non-ferrous metals. Write Airco at address below.

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Air Reduction Canada Limited

NEWS . . . . . *from page 6*

buildings are to be two or three stories, with exterior walls of brick, stainless steel and glass. This expansion program is in addition to the UCC plans for a new home office building on Park Ave., between 47th and 48 th Sts., in New York City.

UCC also has completed plans for increase of uranium production of the Union Carbide Nuclear Co., a division. A uranium processing mill will soon be constructed at Rifle, Colo., with ore-receiving stations and chemical upgrading plants.

Form RW alloy association

Meeting recently at the Park-Shelton Hotel, Detroit, manufacturers of resistance welding electrodes and alloys formally organized the Resistance Welding Alloy Association. Headquarters are at 1900 Arch St., Philadelphia.

Richard H. Taylor of The Electroloy Co., Inc., Bridgeport, Conn., was elected president and James A. O'Grady of Weldaloy Products Co., was elected vice-president.

The purposes and objectives of the RWAA, adopted at the organizational meeting, are:

To foster and promote commercial, industrial and business interests of the RW alloy industry; promote fair practices; to collect and disseminate information; conduct trade promotion activities; analyze distribution channels and methods; study financial and related policies; promote exchange of credit information; promote friendly relations within the industry and with other industries.

Charter members of the new association are: Ampco Metal, Inc.; The Electroloy Co., Inc.; P. R. Mallory & Co., Inc.; Philadelphia Bronze & Brass Corp.; S-M-S- Corp., Detroit,; Tipaloy, Inc.; Weldaloy Products Co.; Welding Sales & Engineering Co.; W W Alloys, Inc.

The new group plans a full program of activities which will also include bimonthly meetings.

Airco expands gas output

Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City, expects to double output of industrial gases at its Butler, Pa., plant with a recently erected steel building. The addition is expected to be in full operation late this year.

The 8,680 sq ft building—standardized steel type—is attached to an end wall of the Butler plant. Across the 62-ft width of the building there is a 10-ton craneway for handling heavy equipment. Aluminum sheets cover the three walls and roof.

According to Airco, the expansion will make an additional 110 tons of gases a day available. The addition is part of a $16,000,000 expansion program for this year.

X-ray symposium to be in Denver

The fifth annual symposium of industrial application of X-ray analysis will be held Aug. 9-10 in Denver.

Sponsored by the metallurgy division of Denver Research Institute, University of Denver, the symposium will meet in the air-conditioned ball room of the Albany Hotel in downtown Denver.

Symposium topics will include application of nondispersive analytical techniques to X-ray spectroscopy; background problem in X-ray emission spectrography; relationship of composition to thermal stability in Huebnerite-Ferberite series; history of computers in crystallography; windowless gas detection method for characteristic X-rays from boron through fluorine; use of proportional flow counters for X-ray spectroscopy; X-ray analysis with proportional counters.

Square D to build plant in Atlanta

Square D Company, Detroit, plans to construct an electrical equipment assembly plant in Atlanta, Ga. The new plant will function as the base of expanded operations in the southeast United States.

Construction of the Atlanta plant in a new industrial development in the city's northwest section, on Marietta Blvd, south of Chattahoochie St., is scheduled to begin shortly.

Involving an investment of $500,000 and designed to permit future additions, the 31,000 sq ft structure will house Square D's regional headquarters offices now located in Atlanta, as well as provide production facilities.

The new installation will warehouse various components used in Square D's electronic welding equipment. Other devices used in conjunction with welding installations will be assembled at Atlanta. This includes certain types of lighting and power panels, circuit breaker units and related equipment.

Wall Colmonoy in new Detroit foundry

Wall Colmonoy Corp., Detroit, has occupied new modern foundry facilities for manufacture of the firm's hardfacing alloys.

The move into the new foundry completes consolidation of Detroit operations under one roof. Sales, research and development, service, and manufacturing facilities are centralized at the firm's general office location at 19345 John R St., Detroit.

The new foundry contains molding equipment, electric melting furnaces and production machinery for manufacture and packaging of welding rods, electrodes and powder. Also included in the new building are expanded assembly, shipping and processing areas for Wall Colmonoy's stainless processing division.

Depke Welding to hold welderama

A two-day welderama and equipment exhibit will be held Sept. 12 and 13 by Depke Welding Supplies, Inc., Danville, Ill. The event, open to the public, will be held at the firm's store at 628 E. Williams St. from 3 to 10 p.m.

Representatives of many welding equipment manufacturers will be present to demonstrate their equipment and answer questions about welding and cutting.

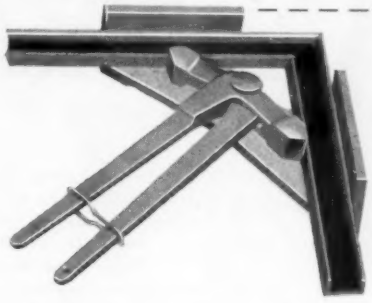
There will be live demonstrations of welding processes, machine cutting, hardfacing. Continuous color motion pictures on various phases of welding will be shown. As an added feature, there will be a new color cartoon on the use of oxygen for medical purposes.

Depke Welding Supplies, in its 29th year as a distributor, has just completed an addition to its Danville store.

Texas supplier in new location

Valley Welding Supply Co., McAllen, Texas, moved to new quarters at 2511 West Highway, in McAllen, on July 15. The new building doubles the firms' floor space.

the POLYP SQUARE SPANNER WELDING FIXTURE



A device to aid in holding stock in position for welding right angles or butts of similar or varied shapes. Clamps rounds, squares, angles, "T" or "H" shapes up to 2¼".

- Positive grip eliminates "creep" usually associated with welding.
- Assures infinitely greater precision.
- Permits "assembly line" methods for job lots of similar or varied work.

Use one for simple welding jobs or use several pre-welding set-ups of more complicated jobs.

Ask your welding supply dealer or write Dept. W-8

FIREARMS INTERNATIONAL CORPORATION
4837 KERBY HILL ROAD, WASHINGTON 22, D. C.

a NEW product . . .
means NEW time saving . . .
important NEW production gains!

York's

SPAT-R-PRUF COMPOUND 106

Don't sputter about spatter . . .
JUST WIPE IT OFF!

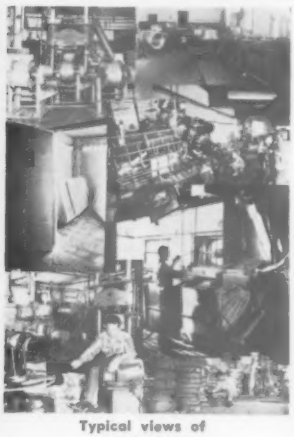
Completely eliminates grinding after welding. Just one coat, and spatter can be wiped away with a dry cloth.

Available 1 or 5 gal. cans, 5 gal. drums

- NO STIRRING OR DILUTION
- NON-TOXIC
- NON-INFLAMMABLE
- NO ODOR
- HARMLESS TO SKIN
- PERFECT PAINT BASE
- HELPS PREVENT RUST
- NO WELD POROSITY

YORK ENGINEERING CO.
2711 S. Kedzie Ave. Chicago 23, Ill.

3 in 1 York's '77'
SPECIAL FLUX
FOR GENERAL BRAZING
FOR CAST IRON WELDING
FOR CAST IRON BRAZING



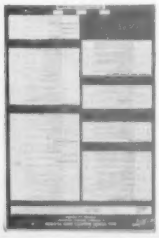
Typical views of ALL-STATE production facilities at White Plains plant

ALLOYS All-State FLUXES

EXPANDING Again!

New construction just completed has added more than a third to ALL-STATE capacity to serve the "metal joinery" needs of industry with alloys and fluxes for welding, brazing, soldering, tinning and cutting.

Ask for "Buyers Guide"



WALL CHART TO HELP YOU SELECT BEST FOR JOB

FROM 86 ALL-STATE PRODUCTS

Put one up in your supply room . . . another on your shop wall . . . to help guide selection of the right Alloy and Flux for the job at hand.

19" x 22" Coated Paper

Ask your A-S Distributor for Copies. He'll also give you same data in a folder to fit 3-ring binder.

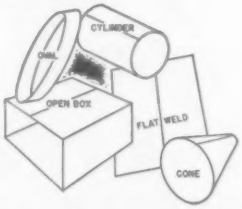
ALL-STATE WELDING ALLOYS CO., INC., WHITE PLAINS, N. Y.

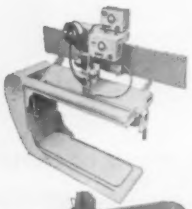
AIRLINE'S "KNOW-HOW" AT YOUR DISPOSAL

THESE TWO FIXTURES CAN GIVE YOU ACCURATE — SMOOTH — PRESSURE TIGHT Fusion Butt Welds

If you make these →

You need these →





AIRLINE MODEL LW SERIES 1000
Longitudinal Welding Fixture

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Morgan Aluminum moves to new plant

Morgan Aluminum Welding Rod Co. has moved into new plant facilities in Mt. Carmel, Pa. Formerly located in Cleveland, the move is expected to increase Morgan's output of aluminum and magnesium welding rods and electrodes by at least 100%.

The new plant is reported to provide modern equipment as well as surroundings. The sales office of the company remains at 840 N. Michigan Ave., Chicago 11, Ill.

Carboloy department has new name

Carboloy department of General Electric Co., Detroit, has been renamed Metallurgical Products department. The new name reflects the company's greater emphasis on specialty metals development and manufacture. Department headquarters remain in Detroit.

Savage Industries in new quarters

Savage Industries, Inc., has moved into modern new quarters at 2045 W. Cheryl Drive, Phoenix, Ariz. Savage is parent company for Arizona Welding Equipment Co., Phoenix, and Aweco Supply Co., Tucson, both welding suppliers.

Radiography

MORE than 40 manufacturers and distributors exhibited testing and scientific apparatus at the 59th annual meeting of the American Society for Testing Material in Atlantic City, N. J. Shown here at the display of North American Philips Co., Mt. Vernon, N. Y., is Alexander Golus explaining process of radiographic inspection to a visitor. (See also WELDING ENGINEER, June, p. 80 and May, p. 133.)

Balbach Co. holds welding conference

The power of effective selling was demonstrated at a welding conference held recently by Balbach Co. at its plant in Rapid City, S. Dak.

More than 331 people registered at the two-day conference, coming from South Dakota, Nebraska, Wyoming and Montana.

Over 25 industrial plants sent representatives to the conference demonstrating how well welding has been sold by Balbach Co. A great many of these plants were represented by weldors or superintendents.

Pupils from schools in the area attended as well as students from the South Dakota School of Mines, a vocational school at Pine Ridge, S. Dak., the West River Trade School in Rapid City and the Chardon State Teachers school, Chardon, Neb.

Live exhibits of an educational nature were conducted throughout the day and evening. Booths were manned by representatives of companies whose products Balbach Co. distributes.

Among the firms represented at the conference were Homestake Mining Co., Black Hills Ordinance Depot, Northwest Engineering Co., Adams Steel Co., Stapp Construction Co., Dakota Steel & Supply Co. *(For more on publicizing welding see editorial,* WELDING ENGINEER, *June, p. 25.)*

Bastian-Blessing increases facilities

Bastian-Blessing Co., Chicago, recently occupied an addition to its warehouse in that city. In addition, the firm has begun construction of an addition to its Chicago plant which will be used for small automatic screw machines. Bastian-Blessing has also increased facilities of its plant in Grand Haven, Mich. The firm is a producer of welding and cutting equipment and supplies as well as soda fountains and accessories.

R. V. May Co. in new building

The R. V. May Co., Prestonsburg, Ky., recently moved into its new building in that city.

Distributor appointments

General Electric Co., Schenectady, N. Y.: Sanders & Stewart, Inc., Jackson, Mich.

Metallurgical Products Department, General Electric Co., Detroit: Voto Manufacturers Sales Co., Inc., Steubenville, Ohio.

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George A. Klasson has been appointed manager of the electric welding division by O. K. I. Welding Supply Co., Cincinnati. He had been regional manager of electric welding sales in the southern Ohio area for Westinghouse Electric Corp. Mr. Klasson will supervise sales and service of electric arc welding equipment, and supplies. He is a member of the American Welding Society.

John D. Gordon has been named general sales manager by Progressive Welder Sales Co., Detroit. Formerly vice-president and general manager of Progressive, he left the company in 1949 to establish his own engineering firm. He has since been associated with the Lincoln-Mercury organization, Packard Motors Co. and Studebaker-Packard Corp.

Gordon

W. J. Reed has been named district manager of the Cleveland office of Alloy Metal Wire division, H. K. Porter Co., Inc., Prospect Park, Pa. He succeeds Peter Stefan, recently promoted to general sales manager.

Bernhard W. Weber has been named manager of manufacturing by Metal & Thermit Corp., New York City. He succeeds *Walton S. Smith*, who recently retired as vice-president in charge of manufacturing. *H. Alfred Rack*, formerly manager of engineering, has succeeded Mr. Weber as production manager. *David Birger Orden* has been named Latin-American representative of M & T. He will headquarter in Mexico City. He is an associate member of the American Welding Society.

Weber

Titanium

HANDBOOK ON TITANIUM, PART I and PART II. Published by Office of Technical Services, U. S. Department of Commerce, Washington, D. C. Part I: 210 pages. Price $3. Part II: 161 pages. Price $4.25.

The properties and production of titanium is the subject of this Air Force Handbook, available in two volumes.

The information was collected through literature survey and personal contact. The work was done by H. K. Adenstedt, staff metallurgist of the Lycoming division, Avco Mfg. Corp., under contract with Wright Air Development Center, U. S. Air Force.

Part I, whose three major sections cover titanium production, physical metallurgy and properties, was completed in August, 1954. Part II with two major sections, covers laboratory procedures and fabrication. It was completed in September 1955, following a year's investigation.

The two volumes may be ordered from the Office of Technical Services. Specify report number: Part I —PB 111631; Part II—PB 111873.

Ship design

THE THEORY AND TECHNIQUE OF SHIP DESIGN. By George C. Manning. Published by Technology Press, Massachusetts Institute of Technology and John Wiley & Sons, New York City, 1956. Cloth, 6 by 9 in., 278 pages. Price $10.

For those interested in ship design, this should prove an informative text. The discussion is clearly presented, allowing the reader, who has only a cursory knowledge of engineering and shipbuilding, to easily follow it.

It should prove of value to the engineer and the executive who must make decisions about matters on which he lacks technical information.

The book opens with a chapter on the philosophy of ship design, moving forward to treatment of preliminary estimates of displacement, elements of form, stability, lines and calculations; design of general ar-

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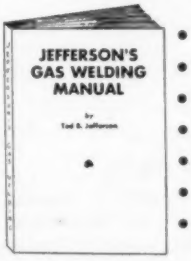

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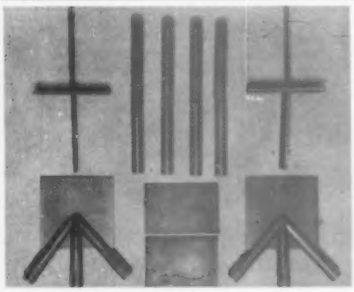

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rangements, strength and weight calculation, contract and final design. An appendix describes computation of riding arm from principal dimensions and coefficients, tailors' mathematic lines and procedure in preliminary design.

Although the book emphasizes science of ship design, it does not overlook the importance of the art expressed in the phrase "good engineering judgment."

Legal reference

LEGAL PROBLEMS IN ENGINEERING. By Melvin Nord. Published by John Wiley & Sons, New York City, 1956. Cloth, 6 by 9 in., 391 pages. Price $7.50.

Legal aspects of engineering are well covered in this work. Written by an engineer, who is also a practicing attorney, it should prove an authoritative book for reference. The book does not pretend to make the engineer independent of legal aid but should help him avoid legal difficulties, before they arise, and to work more effectively with lawyers if they do.

The scope and coverage of this volume is broader than many comparable works. It deals with almost every legal topic that has any bearing on engineering. Treatment of each topic is thorough. A helpful feature is elimination of many needless items of documentary evidence often found in works of this type.

While written primarily for engineers, the text covers fields of interest to small businessmen as well. Examples are contracts, sales, insurance, property, business organizations, patent, copyright and trade mark laws.

Time study

PROCEEDINGS OF THE 19TH ANNUAL TIME & MOTION STUDY & MANAGEMENT CLINIC. Published by Industrial Management Society, Chicago, 1956. 152 pages. Price $5.

These are the proceedings of the 19th time and motion study and management clinic sponsored by the Industrial Management Society, Nov. 9-11, 1955 at the Hotel Sherman, Chicago. The book includes complete transcripts of speeches given by representatives of labor, management and government on such topics as time study, motion economy, methods, plant layout, production control, wage incentives, maintenance, and human relations. Charts, forms and illustrations aid in the discussion presentation.

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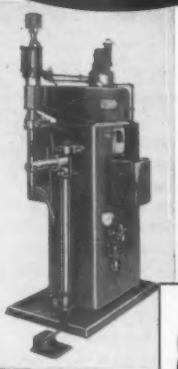

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High temperature

HIGH TEMPERATURE TECHNOLOGY. Edited by I. E. Campbell of Batelle Memorial Institute. Published by John Wiley & Sons, Inc., New York City, 1956. 526 pages. Price $15.

Sponsored by The Electrochemical Society, the volume contains recent developments in the field, summarized by 35 authorities. The aim is to clarify research in developing new materials for service at very high temperatures. The first major section, "Materials", includes discussion of metals, oxides, properties of carbon and graphite at high temperatures.

The second section, "Methods," deals with sintering of metallic and nonmetallic refactory materials, methods of achieving high temperatures (and some of the limitations), and resistance and induction-heated furnaces, and arc furnaces. The last section, "Measurements," treats temperature and its measurement, mechanical properties, physical properties, and special techniques.

ASTE index

DATA SHEET NUMERICAL INDEX, REVISED. Published by American Society of Tool Engineers, Detroit, 1956. Available from National Standards Committee, ASTE, 10700 Puritan Ave., Detroit 38.

The revised data sheet numerical index is adapted from the U. S. Standard Commodity Classification System. The index is designed as a help in selecting, filing, classifying and comparing available tool engineering products. Articles, tables, or data can be numbered and filed for easy reference.

The classification system is as follows: every item or class of items is given a specific seven-figure number. The first two numbers represent the group; a dash and five more numbers break down the group into subclassifications. Under each group there are 90,000 classified and interrelated numbers. The index comes in two parts: numerical listing and alphabetical listing.

Pneumatic valves

JIC PNEUMATIC SYMBOLS. Published by Ross Operating Valve Co., Detroit, 1956. 5 by 8 in, 40 pages. Price $1. Available from the publisher and its distributors.

This booklet lists all JIC symbols for pneumatic valve controls, including a drafting template guide. A coding system keys each of the symbols to the guide code.

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51. ALUMINUM WELDING — All-State Welding Alloys Co., Inc. Illustrative booklet shows how to use alloys, fluxes for welding, brazing, soldering aluminum and its alloys. Booklet has tables, selection aids, melt and flow temperatures.

52. OXYACETYLENE WELDING—Suffolk Iron Foundry (1920) Ltd. Catalog No. 1456 (N) describes, with illustrations, oxyacetylene welding products available, electrodes, torches, regulators, fluxes, including accessories and spare parts list.

53. PYROMETERS—The Bristol Co. 12-page bulletin P1244 features millivoltmeter indicating pyrometers, controllers and switches, with illustrations and specifications.

54. HOSE CRIMPER — Craig Welding Supply Co. Illustrated sheet and brochure describe, with applications, construction of hose crimper able to splice one or both lines of twin hose.

55. ELECTRODES—Champion Rivet Co. 4-page illustrated folder describes the "Speedemon" iron powder electrodes, with recommended usage.

56. MOUNTINGS — Hanna Engineering Works. Bulletin 76 illustrates and gives dimensions and usage of cylinder mountings designed to correct misalignment between cylinders and their loads.

57. CASE HISTORIES — Ampco Metal, Inc. Feature of second quarter issue of *Ampco Welding News* discusses fabrication of filter separators, with inert gas processes. Also includes sprocket salvage, aluminum bronze electrode usage in cement mills.

58. WELDING RELAY—Automatic Switch Co. Bulletin 1054-151S describes current-type welding relays for a-c and d-c control.

59. IGNITRON—National Electronics, Inc. Illustrated technical data sheet discusses "NL-1022" ignitron tube designed for frequency-changer resistance welders.

60. ELECTRODES—General Electric Co. Illustrated pocket-size bulletin GED-3048 gives deposition rates and properties of low-hydrogen, powdered-metal electrodes "Strikeasy LH-1" and "LH-2."

61. MIG WELDING—Air Reduction Sales Co. 12-page booklet reprint (Form ADR 100) entitled "High Speed Welding of Steel Compressor Cases," concerns Mig (metal inert-gas) welding of hermetic line of compressors for refrigeration units.

62. INDUSTRIAL HEALTH — Industrial Hygiene Foundation of America, Inc. 19-page booklet concerns history of the Industrial Hygiene Foundation, devoted to solution of occupational health problems.

63. HOSE, DUCT—The Flexaust Co. 4-page illustrated bulletin 41 details "Flexaust" hose, ducts, including couplings, cuffs.

64. BERYLLIUM COPPER — Beryllium Corp. 4-page illustrated booklet describes, with characteristics, "Berylco" 10 strip, a high conductivity beryllium copper alloy.

65. HEAT TREATING—Hevi Duty Electric Co. Bulletin 653 illustrates and describes vertical, pit type, box type, and other models of heat-treating furnaces.

66. HYDRAULIC CYLINDERS—Galland-Henning Nopak Division. 12-page catalog 104 describes high-pressure hydraulic cylinders; includes engineering, dimensional data.

67. HARDFACING—Haynes Stellite Co. Hardfacing blades, hammers used to pulverize abrasive materials is feature of *Haynes Alloys Digest* (Vol. 7, No. 7).

68. SAFETY HATS, CAPS—The Fibre-Metal Products Co. Illustrated bulletin 45 describes "SuperGard" safety hats adjustable to head size.

69. DUST COLLECTOR—Torit Mfg. Co. Envelope-size booklet, "You Can Solve That Dusty Cost Problem," describes principles of dust collection, its advantages and savings. Illustrated.

70. SPOT WELDER — The Taylor-Winfield Corp. Bulletin 2-063 is 4-page booklet discussing spot and projection impact welder.

71. WHEEL GUARD—Morrison Products, Inc. 4-page illustrated folder describes revolving cup guards for portable grinders.

72. BRAZING, ANNEALING—Gas Appliance Service, Inc. Bulletin 511 is 4-page discussion of brazing, annealing, hardening using turntable-type heating machine.

73. METALLIZING—Metallizing Co. of America. 4-page folder details metallizing with "Mogulectric" metallizing gun. Illustrations and recommended accessories included.

74. BRAZING DATA — Goldsmith Bros. Smelting & Refining Co. "Silver Brazing Data Book" gives complete information about brazing alloys and fluxes for silver brazing.

75. FILTER PLATES, LENSES — Glendale Optical Co., Inc. Pocket-size illustrated folder describes "Metalcote" filter plates and lenses for welding safety.

76. ARC WELDERS—Hobart Bros. Co. Color, illustrated brochure discusses welding with engine-drive arc welders, air or water-cooled, with or without auxiliary power.

77. FUME EXHAUSTERS — Engwald Corp. 4-page illustrated leaflet details welding booth, exhausters, blowers for fume removal in welding operations.

78. TIG TORCH—Tec Torch Co., Inc. Color, illustrated folder discusses water cooled torches for Tig (tungsten inert-gas) welding, with specifications.

79. SHIELDS, RESPIRATORS—Sellstrom Mfg. Co. Folder 32C discusses weldor's shields and respirators, with illustrations.

80. WELDER CONTROL—Square D Co. Bulletin SM236, with illustrations, describes auxiliary welder control types available.

81. GRINDING WHEELS — Metal Removal Co. 12-page illustrated booklet treats small grinding wheels and abrasive discs. Sizes, composition and uses are discussed.

82 HARDFACING—The McKay Co. Illustrated 4-page booklet describes "Hardalloy 1" and "6" low-hydrogen hardfacing electrodes, with characteristics and uses.

83. BELT GRINDER — Curtis Machine Corp. Illustrated circular A1357 describes abrasive belt machine for use in grinding, polishing, deburring.

84. WELDING GUIDE—Sylvania Electric Products Inc. Wall type "Inert Gas Arc Welding Guide" consists of three charts, each devoted to a specific metal, giving recommended electrodes and current setting for manual welding.

85. AUTOMATIC WELDERS — Welduction Corp. Two-color folder discusses automatic welders, positioners, controls for precision fusion welding.

86. SAFETY HAT — Davis Emergency Equipment Co. Bulletin 1412 describes lightweight aluminum safety hat ideal for hot weather.

87. THYRATRON—National Electronics, Inc. Technical data sheet discusses "NL-632B" thyratron for control, timing, ignitor firing applications.

88. PORTABLE WELDER — Mid-States Welder Mfg. Co. Illustrated sheet (Form 100C-155) discusses the "ZipperEt" a-c arc welder, claimed a complete portable welding unit, containing transformer, cables, helmets, holder, torch,

89. TIG WELDING—Tec Torch Co., Inc. Illustrative sheet presents features of "Visuweld" pencil-grip type Tig (Tungsten inert-gas) torch with transparent gas cup. Torch is water-cooled.

90. GRINDING, FINISHING — Carboloy Department. Bulletin GTO-102 covers sizes and shapes of cemented oxide grade "O-30," including holders and accessories. Bulletin GT-311 covers specification for high titanium nickel binder grade "330" finishing carbide, including blanks for cylindrical and square boring tools.

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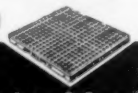

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Literature offered in ads

125. Airline Welding & Engineering—Data and samples on fusion butt welds.

126. Air Reduction Sales Co.—Catalog 1318-WE, "Airco Electrode Guide," to help you select the right electrode for your specific job.

127. Air Reduction Sales Co.—Catalog WE on rods and fluxes for joining both ferrous and non-ferrous metals.

128. Alloy Rods Co.—Complete information on "Arcaloy" stainless-steel electrodes.

129. All-State Welding Alloys Co., Inc.—Wall chart and "Buyers Guide" on alloys and fluxes for welding, brazing, soldering, tinning and cutting.

130. Aluminum Co. of America—Information on aluminum welding, brazing and soldering.

131. Ampco Metal, Inc.—Information on "Phos-Trode" phosphor-bronze electrode.

132. Arcos Corp.—Data on how to get longer service from stainless welded equipment with stainless electrodes.

133. Arcos Corp.—Details on how to get results from submerged-arc welding with stainless coiled wire.

135. Atlas Welding Accessories Co.—Details on weld-cleaning tools and other accessories.

136. Becker Bros. Carbon Co.—Catalog on carbon welder brushes for all makes of welding equipment gives complete specifications, factory numbers, scaled drawings, etc.

137. Cam-Lok Div.—Catalog 131 on making your own waterproof, shockproof and Neoprene-insulated cable connections.

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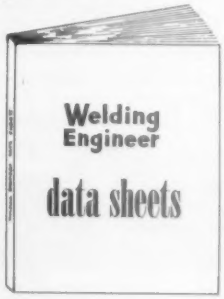

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138. CBC Industries, Inc. — Information on weldor's qualification test kit.

139. Columbia Electric Mfg. Co.—Catalog WE-400 on the "Tong Test" a-c/d-c ammeter.

140. Contour Marker Corp.—Information and instruction book on laying out pipe joints.

141. Drawalloy Corp. — Information on precision-drawn hardfacing and welding wire.

142. Eastman Kodak Co.—Details on new "Type AA" X-ray film for shorter exposures and quicker examinations.

143. Eisler Engineering Co., Inc.—Information on resistance-welding and general welding equipment.

144. Erico Products, Inc.—Details on "Caddy Type B" electrode holders.

145. Federal Machine & Welder Co.—Brochure describes welding press for resistance-welding applications.

146. Fibre-Metal Products Co.—Bulletin 33 describes features of all-insulated "Eureka" holder.

147. Fibre-Metal Products Co.—Bulletin 25 describes the "Simplex" holder.

148. Fibre-Metal Products Co.—Catalog 24 includes leather gloves, protective sleeves, bibs, coats, capes, spats, etc.

149. Fibre-Metal Products Co.—Bulletins 38 and 47 and Catalog 24 describe the "No. 401" welding hand shield and 22 styles of welding helmets.

150. Fibre-Metal Products Co.—Bulletin 41 tells about four "Monarch" face shields and their accessories.

151. Fibre-Metal Products Co.—Bulletin 29 describes "No. F-450" and "No. F-500" headrest safety welding goggles.

152. Fibre-Metal Products Co.—Bulletin 45 describes exclusive features of safety hats and caps.

153. Firearms International Corp.—Information on the "Polyp" square spanner welding fixture to aid in holding stock in position for welding right angles or butts of similar or varied shapes.

154. Foote Mineral Co.—Descriptive literature on fluxes and alloying agents used in the steel industry as well as raw materials used in the manufacture of welding rod coatings.

155. General Electric Co.—Bulletin GEA-6242 on heavy-duty welders, plus a complete line of equipment, accessories, and electrodes.

156. H & M Pipe Beveling Machine Co.—Information on pipe cutting and beveling machines.

157. Harnischfeger Corp.—Catalog and information on arc welders with "Dialectric" control for faster welding at lower cost.

158. Harrisburg Steel Co.—Catalog and prices on high-pressure gas cylinders.

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159. Harris Calorific Co.—Details on faster cutting speeds with the new automatic system.

160. Hobart Bros. Co.—Data on the a-c arc welder/a-c power generator combination in stationary and portable models.

161. Hobart Bros. Co.—Catalog on complete line of electrodes.

162. Hobart Bros. Co.—Details on a-c transformer, electric drive, air-cooled, contractor special, standard gas drive, automatic and d-c rectifier welders.

163. International Nickel Co., Inc.—Booklet, "Inco Welding Products" describes electrodes, wires, rods and fluxes.

164. International Nickel Co., Inc.—Write for technical service, giving details, to help you with welding dissimilar alloys.

165. Jackson Products, Inc.—Information on arc welding and safety accessories.

166. Kedman Co.—Information on welding helmets, face shields and accessories.

167. Krembs & Co.—Flux chart and samples available.

168. Lincoln Electric Co.—Specifications and procedures in Weldirectory SB-1351 on "Fleetweld 57," a-c or d-c iron-powder electrode for mild steel.

169. Linde Air Products Co.—Illustrated literature on wide variety of standard and custom "Unionmelt" welding assemblies.

170. Linde Air Products Co.—Booklet F-8684 on how "Oxweld W-45" torch handles welding and heating jobs.

171. Liquid Carbonic Corp.—Details on "Gasweld" regulators that are set to give two-stage performance at single-stage cost.

172. Mallory & Co. Inc., P. R.—"Resistance Welding Catalog" on electrode holders.

173. Metal & Thermit Corp.—Details on how "M & T" controlled-arc power supply units can help you save time and cutting costs on many semi- and fully-automatic welding operations.

174. Metal Bond Mfg. Co.—Catalog on soldering and welding products.

175. Miller Electric Mfg. Co., Inc.—Details on "Arcweld" welding electrodes and "SRH low-boy" d-c rectifier type welder.

176. National Carbide Co.—Write for name and address of nearest supplier.

177. National Welding Equipment Co.—Details on new compound pressure cylinder manifold.

178. Norris Thermador Corp.—Specification on all sizes of acetylene cylinders.

179. North American Philips Co.—Name of nearest dealer, folder, prices and information on tungsten electrode welding.

180. Norton Co.—Details on the new "B-11" resinoid bonded wheels for weld grinding.

181. Page Steel & Wire Div.—Folder DH-402A on submerged arc and inert gas welding wire.

182. Page Steel & Wire Div.—Booklet DH-1277 on gas welding rods.

183. Picker X-Ray Corp.—Data on industrial radiography (X-ray units for portable and mobile use, or stationary installation; Gamma sources, equipment and containers; and accessories).

184. Reid-Avery Co. — Information on "120-16T" electrodes for welding T-1 steel plate and "Pay-Off-Pak" for automatic submerged-arc welding and inert-gas welding.

185. Shawinigan Products Corp.—Information on carbide.

186. Smith Corp., A. O.—Details on SW-15 electrodes and other welding products and services.

187. Smith Corp., A. O.—Details on "SW-14" and "SW-65" electrodes.

198. Smith Welding Equipment Corp.—Full information on "Pipeliner" welding torch and cutting assembly that cuts, welds, heats, brazes and solders.

188. Stoody Co.—"Guidebook," gives suggestions for prolonging the life of all types of heavy equipment.

189. Stulz-Sickles Co.—"How-to-do-it" details on saving time and money replacing worn metal quicker with "Manganal" wedge bars.

190. Thompson Electric Welder Co.—Detail on ways to reduce or eliminate work handling in your resistance welding operations.

191. Tube Turns, Inc.—Catalog on aluminum fittings, flanges.

192. Tweco Products, Inc.—Descriptive literature on "AL-300 Twecotong" forged aluminum electrode holder and "Tweco-Lite" aluminum welding cable.

193. United Wire & Supply Corp.—Information on "Phoson" brazes.

194. Vickers Electric Div. — Illustrated brochure with complete information on "Controlarc" d-c welder.

195. Victor Equipment Co.—Bulletin 358 on hardfacing with automatic rods for steadier arc and voltage and smoother, faster application.

196. Victor Equipment Co.—Information about safety regulators.

197. York Engineering Co.—Details on how "Spat-R-Pruf Compound 106" eliminates grinding after welding.

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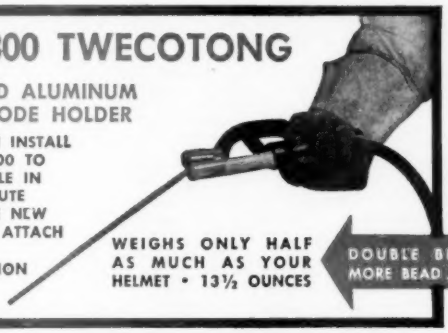

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